

Co-ordination Failure and the Role of Banks in the Resolution of Financial Distress

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Abstract

This article discusses the out-of-court restructuring of the contractual obligations of a financially distressed firm, under conditions of asymmetric information among the firm's creditors and in situations where a creditor bank makes concessions conditional on other creditors' actions. I show that a bank's conditional commitment to support the financially distressed firm may inject a degree of *strategic solidity* among other creditors and reduce the deadweight costs of inefficient liquidation. However, should a bank's concession be made conditional on a high tendering rate by other creditors, this may negate the positive information externality of bank's action. Low minimum tendering rates, on the other hand, may lead to multiple equilibria in creditors' strategies; but, all those equilibria are shown to be Pareto improving of the unique equilibrium when there is no bank in the game.

JEL Classification: C70, D82, G33

Key words: Financial distress, tender offers, global games.

1 Introduction

Empirical evidence suggests that banks play a potentially important role in facilitating the resolution of financial distress. Inspired by Corsetti et al (2001), one possible explanation for this is that the actions of large creditors, such as banks, simply allow small creditors to co-ordinate more efficiently. In particular, if a bank lender chooses to restructure, this may be taken by smaller, possibly less informed creditors such as public debt holders or suppliers, to imply that the going concern value of the firm, and thus the value of new claims offered, exceeds the liquidation value of the firm. In this way, we could argue that banks and other large well-informed creditors act to facilitate the resolution of financial distress by injecting a degree of *strategic solidity* in credit markets.

In the literature, there has been no theoretical work directed at examining this proposition. Rather, this has tended to concentrate mainly on firms' optimal choices between public and private debt, and the agency and other costs associated with diffused versus concentrated ownership of debt when the firm is *out* of financial distress. This is despite a steady accumulation of empirical work that has examined the role of banks in facilitating public debt exchange offers (out-of-court resolution of financial distress) when creditors face co-ordination problems and banks are assumed to own some proprietary, though not necessarily superior, information about the going concern value of the firm.

Mooradian and Ryan (2003) examine cases of out-of-court restructuring of debt and the resolution of financial distress under Section 3(a)(9) of the U.S. Security Act and compare them to investment-bank-managed exchange offers. They find evidence that when a commercial bank makes a concession – which is almost always conditioned on a successful public debt restructuring – the importance of the exchange offer increases and an investment bank is more likely to be involved. Their results suggest that investment banks play a very important role in certifying the exchange and facilitating debt reduction, but unlike commercial banks, they play little if any role in resolving co-ordination problems.

James (1995, 1996) finds evidence consistent with the hypothesis that bank participation in debt restructuring transactions facilitates public debt exchange offers. In particular, he finds evidence that forgiveness of principal by banks induces public-debt holders to accept a debt exchange offer more easily and to reduce principal more aggressively¹. Also the likelihood of achieving minimum tendering rates - which is a typical prerequisite in debt exchange offers - increases². He further finds evidence that transactions in which banks forgive principal typically involve firms with more severe financial distress (e.g. higher leverage), which suggests that banks make concessions only when their claims are likely to be impaired. James (1996) also reports that, in all cases where

¹In fifteen debt restructuring transactions where banks took no action the average reduction in public debt was 19%, while in 14 cases where the bank reduced principle the average reduction in public debt was 56%.

²In all cases where banks offer to scale down their loans actual tendering rates are above the minimum specified for success compared to 30% when banks do not make concessions.

banks make concessions, they make their offers contingent upon the successful completion of the public debt exchange offer.

Asquith, Gertner and Scharfstein (1994) analyse how financially distressed firms try to avoid bankruptcy through public/private debt restructuring, asset sales, mergers and capital expenditure reductions. Using a sample of companies with high-yield, *junk* bond issues with financial difficulties, they find evidence that the firm's debt structure affects the way financially distressed firms restructure their claims. In particular, a combination of secured private debt and numerous public debt issues seems to impede out-of-court restructuring and the firm's debt structure affects the way financially distressed firms restructure their claims.

In contrast to James (1996), Asquith et al (1994) find that banks almost never loosen financial constraints by forgiving principal, while loosening financial constraints does not reduce the probability of bankruptcy³. They argue, however, that their sample is very specific as it focuses on the high-yield bond market, and the results should not be generalised. Gilson, Kose and Lang (1990) find evidence that the likelihood of out-of-court debt restructuring is positively related to the firm's reliance on bank debt.

In the theoretical front, Bolton and Freixas (2000) discuss a model of corporate finance where both supply and demand influence the availability of finance within an equilibrium set-up with asymmetric information. They argue that banks can help firms in times of distress because they can exploit their superior information/borrower screening skills. In addition, an important feature of their model is banks' ability to securitise senior portions of *rescue* finance they extend to firms in distress (e.g. in a *debtor-in-possession* situation) and avoid the incentive to liquidate inefficiently a firm in financial distress. In equilibrium, banks choose to increase their supply of loans, provided that they can price effectively for the extra risk and they are not capital constrained. That way bank loans may substitute for other forms of finance and facilitate the resolution of financial distress.

Diamond (1993) argues that, because bank lenders are generally secured, they have little incentive to make concessions. Gertner and Scharfstein (1991) provide a model that illustrates how bank participation in the restructuring transaction can mitigate *holdout* problems among public debt-holders. In doing so, however, they assume common knowledge about the firm's economic fundamentals which allows perfect co-ordination of creditors' actions.

Jaffee and Shleifer (1990) examine how investment banks protect firms from financial distress due to self-fulfilling failure of calls of convertible bonds. They provide an analogy to Diamond and Dybvig's (1983) bank runs model by arguing that, by underwriting the forced conversion of convertible bonds, investment banks essentially provide insurance (a put option) to the firm in the same way that deposit insurance provides protection against bank runs.

³59% of firms whose banks loosen financial constraints still went bankrupt vs. 68% of the firms whose banks tighten the constraints, though there are differences in restructuring periods until bankruptcy.

Yet Jaffee and Shleifer assume that the economic fundamentals of the firm i.e. the value of firm's assets, is common knowledge among creditors and there is no uncertainty about equilibrium behaviour of creditors. This allows perfect co-ordination of creditors' actions and results in multiple Nash equilibria⁴. Moreover, it implies that there is only risk shifting from the firm to the bank and there is no information content in an investment bank's action to accept the underwriting. It is exactly that information content that is central to our analysis.

Giammarino (1989) models the resolution of financial distress under Chapter 11 proceedings as a non-cooperative game of incomplete information played by a firm and a single creditor. He considers a model of financial distress of a firm with equity entirely owned by a single risk-neutral individual and debt outstanding which is entirely owned by a perfectly co-ordinated group of risk-neutral debt-holders. He shows that, despite the possibility of costless, out-of-court reorganisation, it may be rational for firms to incur significant financial costs in the resolution of financial distress due to the existence of asymmetric information and judicial discretion.

In this paper, we consider an out-of-court renegotiation of contractual obligations in a setting that is similar to a debt exchange offer, where a firm, a bank creditor and a continuum of small claimants to the firm interact in an environment of asymmetric information about the firm's solvency condition. Solvency condition is defined with respect to the ability of the firm to repay all its contractual obligations after the completion of a risky project that currently has in place. We investigate the extent to which acceptance by the bank to commit further funds to the firm (e.g. via a new loan), facilitates contract revision offers by other creditors⁵.

In our model, the bank is a *large* creditor by virtue of its non-negligible financial mass, while individual small creditors are assumed to be of measure zero. In that sense, the game is *asymmetric*. Although the size of the bank can be small, compared to the balance sheet of the financially distressed firm, and insufficient just by itself to manufacture a bail-out of the firm, its size is not of zero measure. Moreover, the actions by the bank are assumed to be common knowledge among other creditors before they choose their own actions. In that sense, the game is *sequential*. Consequently, in equilibrium, the bank recognises both the information and the money-effect of its own action, while individual small creditors fail to see those effects in isolation and can only consider their impact as a whole.

Throughout the paper, we assume that a bank creditor has an information advantage over other creditors. This is consistent with the literature on the importance of banks' monitoring abilities and how banks might get access to better information compared to other types of creditors⁶. In particular, we focus

⁴For a discussion on this issue see Morris and Shin (2000)

⁵Hereinafter, the words *claimants* and *creditors* may be used interchangeably.

⁶That literature includes, among others, Bolton and Freixas (1998, 2000), Holmstrom and Tirole (1997), Houston and James (1996), Rajan (1992), Lummer and McConnell (1989), Fama (1985), to mention but a few.

on the limited case where the relative precision of small claimants' information relative to that of the bank tends to zero. This is without loss of generality and it is necessary for maintaining tractability in our analysis and deriving a closed form solution for equilibrium strategies⁷.

The basic feature of our analysis is that agents in the model exhibit *full strategic complementarities*. That is, the expected payoff to an agent from undertaking a certain action increases the higher the proportion of other agents that undertake the same action. This allows us to use the methods of Carlsson and van Damme (1993) and Morris and Shin (2002) on *global games* and to focus on equilibrium *trigger strategies* around critical levels of agents private information (signals). Given full strategic complementarities, those trigger strategies can be shown to be the only *dominant solvable* equilibrium strategies of the restructuring game that we consider. Yet, an innovation of the model that adds to the existing literature on global games is that we introduce conditionality in the actions by one class of players – in particular, by the bank – conditional on the actions that are taken by the other class, namely the small claimants.

The analysis shows that a bank, by accepting to extend further credit to a firm in financial distress conditional upon acceptance of a contract revision offer by some proportion of small claimants, it may inject a degree of *strategic solidity* in credit markets and facilitate the resolution of financial distress. This result is consistent with empirical evidence that shows that acceptance by a bank to commit further to a financially distressed firm facilitates contract revision offers to other creditors (e.g. James 1995,1996). In particular, we show that contract revision offers become *successful* at lower levels of firm's fundamentals⁸ compared to the situation where the bank has no role to play in the debt restructuring, controlling for money-effects. This implies, lower deadweight costs of inefficient liquidation when a bank is in the game compared to the situation where there is no bank in the game.

The intuition that underlies the above proposition is that, in large-scale debt renegotiations, which typically involve the restructuring of both public and private claims, the actions taken by banks are usually observable and a bank's response to a debt renegotiation can influence, to a greater or lesser extent, the equilibrium strategies of other creditors through two different paths: First, through the non-zero financial mass of the bank and the non-negligible amount of funds it is able to extend/rollover. Second, even controlling for money-effects, a bank's involvement may affect the beliefs of other creditors regarding the fundamentals of the financially distressed entity in a way that induces a more efficient outcome of the debt renegotiation.

Moreover, a bank, by accepting a restructuring offer conditional upon acceptance of the debt exchange offer by a minimum proportion of public debt holders (*minimum tendering rate*), may allow both itself and other creditors to make better informed decisions. This is, conditional offers may permit aggregation

⁷In a similar setting, Corsetti et al (2001) show numerically that the direction of results is robust to any level of relative precision of agents' private information.

⁸For our purposes, *fundamentals* of the firm are defined with respect to the cash generating power of the firm's project upon its completion.

of individual information and allow individual creditors to base their actions on the collective wisdom of other creditors. However, we show that the positive signaling effect of a bank's concession to rollover its credit to a financially distressed firm, may be undermined should that consent be made conditional upon acceptance of a restructuring offer by a relatively *high* proportion of small creditors. In other words, excessive conditionality, in the form of *high* minimum tendering rates, may negate the positive information externality of a bank's acceptance on the decisions of other creditors. This is regardless of our basic assumption that the relative precision of small claimants' information relative to that of the bank tends to zero.

On the theoretical front, we also derive an important result that relates to equilibrium implications of conditionality on creditors' strategies: We find that, for relatively low levels of conditionality (e.g. low minimum tendering rates), there are multiple equilibria in trigger strategies that are followed by the bank and small creditors. More specifically, for low conditionality levels, there is a one-to-one mapping from bank's trigger strategies to those followed by small creditors and vice versa. Moreover, we demonstrate that a bank's trigger strategy becomes a strictly decreasing function of the strategy that is followed by other creditors, which implies that high equilibrium trigger strategies by one class of creditors is good news for the other class, which then choose to follow a low trigger strategy in equilibrium. However, under relatively high conditionality levels, there is a unique equilibrium in small creditors' strategies that does not depend on the strategy that is followed by the bank. The bank's strategy, then, is defined uniquely as a function of the small claimants' unique trigger strategy.

However, the above theoretical result does not lead to indeterminacy regarding the role of banks in the resolution of financial distress. In fact, all multiple equilibria that may result from a bank's conditional involvement in a debt renegotiation are shown to be Pareto improving compared to the unique equilibrium that we derive when a bank is not in the game. In other words, all equilibria under a bank's involvement imply resolution of financial distressed at lower levels of firm's fundamentals compared to the situation where there is no bank in the game, which then implies lower deadweight costs of inefficient liquidation.

Throughout this paper we adopt a fairly generic characterisation of the financially distressed entity and we do not make any specific reference to the ownership structure of that entity, the role for equity capital, or potential conflict of interests between shareholders and bondholders in the spirit of Jensen and Meckling (1976). Thus, our analysis by-passes possible conflicts of interest between different classes of security holders and concentrates on the workouts of financial distress, the potential inefficiencies that may arise from creditors' co-ordination problems and how those inefficiencies can be alleviated via the involvement of a bank creditor. Consequently, our analysis does not allow for the simultaneous treatment of both co-ordination problems among creditors, when the firm is *in* financial distress, and potential moral-hazard problems associated with the terms of lending at origination, when the debtor is *out* of financial distress. This, however, is a subject that we consider for future research.

The generic characterisation of the firm's balance sheet allows us to add some thoughts that stretch beyond the resolution of financial distress in the corporate sector and relate to the resolution of international financial crisis. In particular, we could draw a parallel between the balance sheet of the financially distressed firm in our model, and the capital account of a country during the onset of financial crisis. We could then discuss implications of our model for the *doctrine of catalytic finance* and the scope and rationale for IMF lending to a debtor country when that country faces a situation, or the possibility, of financial distress.

In September 2003, for example, the Brazilian government has authorised the negotiation of a new, one-year deal with the IMF. The government's Treasury secretary, Joaquim Levy, was then quoted as saying⁹

...Obviously, our objective is to walk alone and not depend on the fund. But a one-year renewal could be an important mechanism of information to investors who did not follow Brazil's progress closely.

The above statement is striking given the strong criticism of the IMF by president da Silva for more than twenty years in opposition. But, it also suggests that there is possibly something more than money in the involvement of the IMF in the resolution of financial distress. Namely, IMF lending may act as a *mechanism of information* that permits less informed – and possibly *small* – creditors to co-ordinate more efficiently. This is consistent with the result of our paper that large, informed creditors may act as *gate keepers* to the system and, should debtors' fundamentals justify it, inject a degree of *strategic solidity* among other creditors.

The remainder of the paper is organized as follows: Section 2 discusses the model. The solution proceeds in steps in sections 3, 4 and 5. Section 6 concludes and adds some thoughts on possible implications for the role of catalytic finance in the resolution of international financial crisis. Proofs of our results are included in the appendix.

2 The Model

We consider a three-period setting $\{\tau = 0, 1, 2\}$ in which a firm with a risky project, a large creditor and a continuum of small claimants (suppliers) to the firm interact in an environment of asymmetric information. To model strategic interactions among agents we use the methods of Carlsson and van Damme (1993) on *global games* as applied by Morris and Shin (2000, 2001), Rochet and Vives (2001) and Goldstein and Pauzner (2000).

Instead of focusing explicitly on debt exchange offers to a diffuse set of public-debt holders, we consider the case where a set of asymmetrically informed suppliers to the firm are asked, through a take-it-or-leave-it offer, to

⁹FT, September 12, 2003.

make concessions about the timing of their payment and the delivery of inputs to the firm. This assumption is without loss of generality and, as it will become clear later, it is made solely in order to simplify agents' payoff functions.

2.1 Agents

There are three types of risk-neutral agents: the firm's owners (the firm) that run a risky project, the firm's banker (the bank), whose financial resources are limited, and a continuum of firm's non-equity stakeholders (suppliers). At date $\tau = 0$ the firm has equity capital E and long-term secured bank debt (loan) with face value B and maturity at $\tau = 2$. The firm also signs identical contracts with the suppliers that promise to deliver inputs for the project at date $\tau = 1$ ¹⁰. Inputs are project-specific and if suppliers will not deliver at date $\tau = 1$ they have to sell the inputs at a discount elsewhere. We also assume that at $\tau = 1$ the firm has a number of obligations to other parties (e.g. employees) of total amount equal to C .

2.2 Investment

Initial investments are made at date $\tau = 0$ when the bank loan (B) and equity capital (E) are used to finance firm's liquid asset reserves (L) and firm's investment (I_0) in an illiquid risky project. At date $\tau = 0$ the firm also places orders to the suppliers for an aggregate quantity Q of inputs with payment taking place upon delivery at $\tau = 1$. Firm and suppliers agree on a price per unit of inputs produced equal to unity¹¹.

Bank-debt is held by a *large* well-informed bank while supply contracts are signed by a diffuse set of small, poorly informed suppliers. The bank is a large creditor by virtue of the face value of the loans it extends to the firm compared with the individual credit lines extended by non-equity stakeholders which individually are considered negligible as a proportion of the whole (i.e. of measure zero).

At date $\tau = 1$ the firm requires a minimum quantity of new inputs rQ (where, $0 < r < 1$) in order for the project to reach its final stage and generate a return \hat{R} at date $\tau = 2$. Otherwise the project must be abandoned and the firm is liquidated.

The minimum proportion of inputs (r) that has to be delivered in order for the project to continue could be interpreted as the *minimum tendering rate* in a debt exchange offer if instead of suppliers we were considering a continuum of public debt holders (e.g. short-term commercial paper investors). The quantity $(1 - r)$ could also be regarded as the maximum contraction of firm's operations before the firm becomes unable to operate as a going concern.

¹⁰As in Berlin and Saunders (1996) our setting assumes suppliers cannot be paid up front.

¹¹Although we do not intend to derive explicitly the optimal loan level and quantity of inputs agreed to be supplied, the liability structure of the firm allows us to capture strategic interactions between the claimants of the firm.

Moreover, at $\tau = 1$ the firm needs an amount of cash (C) in order to cover a number of necessary operating expenses (e.g. labour costs). Failure to meet those obligations at $\tau = 1$ would result in severe disruption of firm's operations, abandonment of the project and liquidation.

We distinguish between *insolvency* and *illiquidity* by defining solvency in terms of firm's ability to meet its contractual obligations at the final date ($\tau = 2$) out of project's payoff. We adopt the following definition:

Definition 1 *At date $\tau = 1$ the firm is considered to be solvent if and only if it is considered capable of meeting all its contractual obligations (i.e. both to the bank and to the diffuse set of claimants) at the final date ($\tau = 2$).*

Now, let (L) be the book value of the firm's liquid assets at date $\tau = 0$. This implies the following accounting identity.

$$I_0 + L = B + E$$

As of date $\tau = 0$, the liquidation value \underline{L} of firm's liquid assets at the intermediate date ($\tau = 1$) is a random variable with the following probability distribution:

$$\underline{L} = \begin{matrix} \frac{1}{2} \\ L_H & w.p. & p \\ L_L & w.p. & 1 - p \end{matrix}$$

where, subscripts H and L stand for *high* and *low* respectively and $L_H > Q + C$ and $L_L \leq Q + C$. In other words, $1 - p$ is the ex-ante probability of financial distress at the intermediate date¹². In this model liquidity shocks are considered exogenous and relate to the marketability of firm's liquid assets (e.g. due to general market conditions).

At date $\tau = 1$ the firm has to pay its suppliers (Q) and cover its operating expenses (C). Firm's liquid asset reserves can then be used as a means for payment. The liquidation value of the project is small relative to the size of the firm's balance sheet and we normalise it to zero. In case of liquidation, we assume that priority rules are enforced for secured lenders. As of date $\tau = 1$, supply contracts may be cancelled (foreclosed) at a cost (c) should the firm claim that it is unable to pay the initially agreed price per unit of supplied inputs¹³. This formulation is in line with Berlin et al (1996)¹⁴.

¹²Assuming common knowledge of the parameters, a necessary condition for investment to take place at the initial date is:

$$pL_H + (1 - p)L_L > Q + C$$

¹³We proceed by assuming that the claim, by the firm, that it faces liquidity problems is truthful and reveals the fact that $L = L_L$. In other words, there is no gaming from the firm in order to extract value from its creditors.

¹⁴Berlin et al (1996) consider a similar situation, yet, with a perfectly co-ordinated set of suppliers, where suppliers may choose to terminate an established supply relationship with a firm should that relationship be severed by the firm.

3 The Problem

We impose the following structure on the problem. At date $\tau = 1$ the firm is in financial distress (i.e. $L = L_L$) and has not enough resources to pay in full its suppliers (Q) and to cover its operating costs (C). Moreover, we assume that the liquidation value of firm's financial slack is not even enough to repay in full its debt to the bank (B) in case of *acceleration* of debt at $\tau = 1$ (i.e. $L_L < B$). For notational convenience and without loss of generality we set $L_L = 0$. The firm is also unable to raise money by selling new securities to outside investors.

Yet, the firm needs at least proportion (r) of the aggregate input quantity (Q) and an amount of cash equal C in order to meet its operating costs and continue with the project until the final period. In order to avoid liquidation and pursue a value enhancing project the firm requests the bank to provide a capital injection $B^1 = C$ in the form of senior unsecured loan. Should the bank agree to provide the new loan the firm also has to offer a new contract to its suppliers in exchange of the old one. The exchange offer should allow the firm to receive the necessary amount of inputs in order to carry on with the project

3.1 The Debt Restructuring Offer

The debt restructuring offer by the firm takes the form of a take-it-or-leave-it offer. The offers to suppliers are identical and provide the delivery of inputs at date $\tau = 1$ in exchange of an unsecured debt claim to the firm payable at $\tau = 2$ (e.g. bill of trade, promissory note etc.) for every unit of inputs delivered. The debt claims are payable at $\tau = 2$ and each one has a face value equal to α_s . In order to deal with *hold out* problems we assume that $\alpha_s > 1$.

Definition 2 *The renegotiation of supply contracts is considered successful if and only if at least proportion r of firm's suppliers accept to deliver at $\tau = 1$ in exchange of unsecured debt claims payable at $\tau = 2$.*

We assume that suppliers' responses to the contract revision offer are pooled together and inputs are released in exchange of debt contracts only if the renegotiation of supply contracts is successful¹⁵.

Moreover, in line with empirical evidence (James (1996)), we assume that acceptance by the bank to extend new credit is made contingent upon successful completion of the renegotiation of supply contracts. In other words, a necessary condition for the bank to extend the new loan and for tendering suppliers to deliver the inputs is that a minimum proportion (r) of suppliers accept the new contract terms.

¹⁵An alternative interpretation of the contract revision offer is to consider it a debt exchange offer to a diffuse set of public debt holders with minimum tendering rate r . The Trust Indenture Act of 1939 prohibits any change in the timing or amount of public debt payments and forces public debt restructurings to take the form of exchange offers. Under debt exchange offers firms offer new claims to debt holders that accept to tender with the offer typically made contingent on the acceptance of a minimum proportion of the public debt (see, for example, Gertner and Scharfstein (1991)).

3.2 Bank's Payoff Function

At date $\tau = 1$ the firm has no collateral to offer but both the old and the new loan to the firm rank first in the firm's capital structure. Yet, if the bank rejects the offer then the firm will be liquidated immediately (e.g. under Chapter 7 proceedings). In that case, the seniority of the old claim to the firm is of no value given that the claim is severely impaired (actually is worthless) due to zero liquidation value of the firm at $\tau = 1$. Given also that bank's agreement to extend new credit to the firm is made conditional upon successful completion of the exchange offer to suppliers, the loss that the bank will incur if default takes place at $\tau = 1$ is limited only to the old loan amount (B). In case of default at $\tau = 2$ the bank has the first claim on what the project has generated up to the total loan amount ($B + C$). Yet, if there is no default at all, the bank fully recovers both the new and the old loan amount ($B + C$). The following table summarises the bank's loss function under different scenarios:

Bank	<i>Default at $\tau = 1$</i>	<i>Default at $\tau = 2$</i>	<i>No Default</i>
<i>Accept</i>	$-B$	$-LGD \times (B + C)$	0
<i>Reject</i>	$-B$	-	-

where, LGD is the loss-given-default (e.g. internal-systems-based) associated with the situation where there is default at $\tau = 2$ ¹⁶. For convenience we assume that $-LGD \times (B + C) < -B$, or that $LGD > \frac{B}{B+C}$. This assumption intends to capture the non-trivial nature of bank's commitment to extend new credit at $\tau = 1$. This is, the amount of new credit C is not negligible compared with the original amount B . Moreover, banks usually claim that it is their policy when they extend credit to make sure that the firm is solvent. In other words, the provision of extra security (i.e. enhanced seniority, collateral etc.) other than affecting the terms of lending it is not the driving force behind bank's decision to extend credit or not. As a result, it would be conceptually wrong, on an ex-ante basis, to relate explicitly the bank's payoff in case of default at $\tau = 2$ to the firm's liquidation value. This would obstruct us from the original objective which is to capture the effect of bank's belief about the *solvency* status of the firm on small claimants' actions. Furthermore, it would computationally burden our analysis making it very specific to distributional assumptions about agents' signals¹⁷.

3.3 Suppliers' Contingent Payoffs

We assume that inputs are project-specific and if suppliers choose not to deliver at date $\tau = 1$ they have to sell the inputs at a discount (c) elsewhere¹⁸.

¹⁶The use of a fixed LGD is consistent with the *foundations internal-ratings-based IRB* approach that has been proposed by the Basel Committee on Banking Supervision. The *IRB* approach requires banks to assign a fixed LGD figure to particular classes of credit exposures.

¹⁷Even the uniqueness of trigger strategy equilibrium could be lost.

¹⁸We use that assumption in order to avoid the complication of explicitly building the term structure of credit spreads into the model or arbitrarily assume a gross rate of return ($r > 1$)

Rochet and Vives (2001) use a similar formulation where they interpret a fixed foreclosure cost (c) as a reputation cost of fund managers due to *bad judgement*. Such an interpretation would be applicable to our model should instead of a continuum of suppliers we would assume a continuum of unsecured creditors (e.g. short-term commercial paper investors).

We also assume that, on an ex-ante basis, suppliers expect to receive a small fixed payoff (l) in case of default and liquidation of the firm at $\tau = 2$. For simplicity we set that contingent payoff equal to zero¹⁹. This assumption is without loss of generality, although one could argue that suppliers' expected pay-off conditional on default at $\tau = 2$ should be determined endogenously as a function of the proportion of suppliers that accept the offer. Yet, this would bring undue complication in the model given that what we intend to capture is suppliers' incentives to avoid the cost of not selling their inputs to the monopolist firm, or of extending credit to an insolvent firm. This assumption is also consistent with empirical evidence. White (1983), for example, observes that unsecured creditors receive little or no payoff in liquidation²⁰. He also argues that some unsecured claims such as trade creditor claims are generally not covered by subordination agreements and rank at the bottom of the seniority ranking.

If there is no default both at $\tau = 1$ and $\tau = 2$, suppliers not only recover the originally contracted amount per unit of inputs supplied, but also a premium (i.e. $\alpha_s - 1$) above that amount. Given the above, suppliers' loss function looks as follows:

Suppliers	<i>Default at $\tau = 1$</i>	<i>Default at $\tau = 2$</i>	<i>No Default</i>
<i>Accept Offer</i>	$-c$	$-l$	$\alpha_s - 1$
<i>Reject Offer</i>	$-c$	$-c$	$-c$

Where, $0 < c \leq 1$ and $-c < 0 < \alpha_s - 1$ because of $\alpha_s > 1$.

3.4 Information

At date $\tau = 0$, the minimum proportion of required inputs (r), the probability distribution of firm's liquid assets at the intermediate date, the level of bank debt (B) and the aggregate claims by firm's suppliers (Q) as well as the level of operating expenses (C) and the cost (c) of selling the goods in the outside market are common knowledge among agents. We also assume that, as of date $\tau = 0$, the return \hat{R} of the firm's risky project has an improper prior distribution²¹.

at $\tau = 1$ for every dollar of credit extended by suppliers to the firm at $\tau = 1$.

¹⁹In a similar setting, Rochet and Vives (2001) use a payoff equal to zero assuming that this is what a fund manager would get for rollovering a credit exposure to an entity that has subsequently defaulted.

²⁰In a sample of 178 liquidated firms White (1983) finds that the average payoff rates to unsecured creditors is approximately 2.5%. Nevertheless, for firms reorganising under Chapter 11 proceedings the payoff rates are above 32%.

²¹Improper priors allow the analysis to focus exclusively on agents' updated beliefs conditional on their private signals, without taking into account the information contained in the

At $\tau = 1$, creditors receive private noisy signals about the return of the firm's risky project. Those signals constitute the only information available to creditors about the economic value of firm's investment. Let y be the signal observed by the bank, which is of the following form:

$$y = \hat{R} + \nu\varepsilon$$

where, $\nu > 0$ is a constant and ε is a normal random variable with zero mean and unit variance, density function $g(\cdot)$ and is independent of R . We denote by $G(\cdot)$ the cumulative distribution function of $g(\cdot)$. Also at $\tau = 1$ each supplier i privately observes the following signal:

$$x_i = \hat{R} + \sigma\varepsilon_i$$

where, $\sigma > 0$ is a constant and $\{\varepsilon_i\}$ are independent, identically distributed normal random variables with zero mean, unit variance and density function denoted by $f(\cdot)$. They are also independent of ε . We denote by $F(\cdot)$ the cumulative distribution function of $f(\cdot)$.

Rational creditors will use their noisy private signals in order to form beliefs about the return \hat{R} of the firm's risky project and to infer the beliefs of other creditors. Thus, a creditor will form beliefs not only about the underlying fundamentals of the firm, but also about the beliefs of other creditors, other creditors' beliefs about other creditors' beliefs and so on. This is because rational creditors will realise that their payoffs do not only depend on the firm's fundamentals, but also on other creditors' whether or not to restructure.

At $\tau = 1$, the bank moves first and decides whether to increase its leverage to the firm. It does so conditional on its private signal (y) and taking into account the effect of its action on suppliers' behaviour. Suppliers then decide unilaterally whether to extend credit to the firm by delivering their goods at $\tau = 1$ for payment at $\tau = 2$. Their actions are conditional upon their private signals (x_i) and the commonly observed action by the bank to extend new credit to the firm or not. We consider the following definition:

Definition 3 *A creditor's strategy is a rule of action that maps each realization of its signal to one of two actions: to extend credit to the firm by accepting the offer, or to reject the offer.*

Suppliers strategies are determined at equilibrium by balancing the benefit of a particular strategy against the opportunity cost of that strategy, taking into account strategic complementarities. Given that individually they are unable to influence the solvency of the firm, suppliers fail to account for the effect of their individual decisions on the completion of firm's project. Yet, they are able to account for the effect of their actions as a whole. Thus, they foreclose whenever

prior distribution. In any case, our results with the improper prior can be seen as the limiting case as the information in the prior density goes to zero. See Hartigan (1983) for a discussion of improper priors, and Morris and Shin (2000) for a discussion of the latter point.

the expected benefit $(1 - c)$ of doing so is higher than the expected benefit of extending credit to the firm via the new contract:

Similarly, the bank accepts to provide new credit to the firm if the total amount it expects to lose from doing so is less than the old loan (B) that it will definitely lose if it will reject the offer.

Let us suppose that suppliers and the bank follow trigger strategies around critical signal levels x^* and y^* respectively. In case where x^* and y^* are uniquely determined it can be shown that there is a unique, dominance solvable equilibrium where suppliers and the bank follow their respective trigger strategies around x^* and y^* ²².

4 Suppliers' Equilibrium in Trigger Strategies

Let (R^*) be the critical level of actual investment return below which a proportion of suppliers higher than $(1 - r)$ rejects firm's proposal. We first prove the following two lemmas.

Lemma 1 *Given suppliers' equilibrium in trigger strategies (x^*), the critical level of actual investment return (R^*), below which proportion of suppliers less than r accept the tender offer, is given by: $R^* = x^* - \sigma F^{-1}(1 - r)$.*

Proof. See Appendix. ■

Lemma 2 *If there is no liquidation at the interim date then, conditional on i supplier's signal being $x_i = x^*$, the proportion (l^*) of suppliers that receive a signal lower than x^* is given by: $l^* = \frac{(1-r)}{2}$.*

Proof. See Appendix. ■

Without apology, both for this section and the rest of the paper, we have assumed that the realised sample distribution of suppliers is always the common distribution of suppliers' signals²³.

We are ready now to solve for suppliers' equilibrium in trigger strategies.

4.1 Suppliers' equilibrium

Conditional on bank's acceptance to extend new credit to the firm, the critical value (x^*) of suppliers' $\{i\}$ signal solves the following equation:

$$\begin{aligned}
 & -c \Pr \hat{R} < R^* \mid x_i = x^*, y > y^* - \\
 & - \Pr \hat{R} < B + C + a_s(1 - l^*)Q \mid x_i = x^*, y > y^* + \\
 & (a_s - 1) \Pr \hat{R} > B + C + a_s(1 - l^*)Q \mid x_i = x^*, y > y^* = -c \quad (1)
 \end{aligned}$$

²²See, for example, Corsetti, C., Dasgupta, A., Morris, S., and H. S. Shin (2001).

²³In lemma (2) for example, one could derive any proportion of suppliers between zero and $(1 - r)$ depending on how he extends the Lebesgue measure.

The first term on the LHS of expression (1) corresponds to the situation where the tender offer is not successful. In that case, suppliers have to sell their goods elsewhere and face a discount. The second term refers to the situation where the tender offer succeeds but there is default at $\tau = 2$ because of insufficient proceeds from the project. Finally, the last term on the LHS corresponds to the situation where the project generates sufficient proceeds at $\tau = 2$ to repay all creditors. On the RHS of (1) there is just the cost that a supplier will face by refusing to deliver to the firm and by selling his inputs elsewhere.

From now on we are going to assume that the relative precision in the bank's signal $\frac{1}{v}$ relative to that of the small creditors $\frac{1}{\sigma}$ is such that $\frac{v}{\sigma} \rightarrow 0$. As of Corsetti et al (2001), this is without loss of generality and it is a necessary assumption in order to keep our analysis tractable.

Proposition 1 *If the bank accepts to commit more funds (C) to the financially distressed firm, conditional on success of the tender offer to small creditors with minimum tendering rate (r) then, if r is such that $r \geq F \frac{y^* - x^*}{\sigma}$ small creditors' equilibrium in trigger strategies (x^*) is given by:*

$$x^* = (B + C) + a_s \frac{1+r}{2} Q + \sigma F^{-1} \frac{(1-r)(1-c)}{a_s} \quad (2)$$

However, if $r < F \frac{y^* - x^*}{\sigma}$ then, small creditors' equilibrium in trigger strategies (x^*) satisfies the following expression:

$$a_s F \frac{x^* - (B + C) - a_s \frac{(1+r)}{2} Q}{\sigma} = (1-c) F \frac{x^* - y^*}{\sigma} \quad (3)$$

where, y^* is bank's equilibrium in trigger strategies.

Proof. See Appendix ■

However, proposition 1 implies that for sufficiently high minimum tendering rates (r), in particular for $r > F \frac{y^* - x^*}{\sigma}$, there is a unique equilibrium in suppliers' trigger strategies (x^*), which only depends on the model parameters and is independent of the strategy (y^*) that is followed by the bank. This is despite our basic assumption that the relative precision of small claimants' information relative to that of the bank tends to zero.

The intuition that underlies this result is simple: If a tender offer is subject to a high minimum tendering rate, both the bank and suppliers know ex ante that, if the tender offer succeeds, a high proportion of suppliers – meaning, higher than the already high minimum tendering rate – will have observed relatively "good" signals. Given that suppliers have nothing to lose from accepting an offer that fails, conditionality in bank's acceptance means, in fact, that the bank accepts to commit more funds to the firm only under the (very) good state that the tender offer succeeds. Thus, suppliers have nothing substantial to learn from the bank's action and, as a result, their equilibrium strategies do

not depend on the bank's strategy y^* . In other words, under high minimum tendering rates, even a bank with a bad signal about the fundamentals of the project would possibly accept the offer, leaving suppliers to decide, on the basis of their "collective wisdom", whether the project is good or bad. Given that, in equilibrium, suppliers are aware of that, they recognise that there is clearly not much (actually nothing) to be learnt from the bank's action. Interestingly enough, this is regardless of the bank's information being infinitely more precise than their individual signals.

Proposition-1 also suggests that, if the minimum tendering rate (r) is less than $F \frac{y^* - x^*}{\sigma}$, the information that is entailed in the bank's action is of value to suppliers, whose trigger strategies (x^*), then, depend on bank's equilibrium strategy (y^*). Taking the equilibrium strategy (y^*) that is followed by the bank, as given, there is a unique x^* that solves equation (3). This is shown in the following figure:

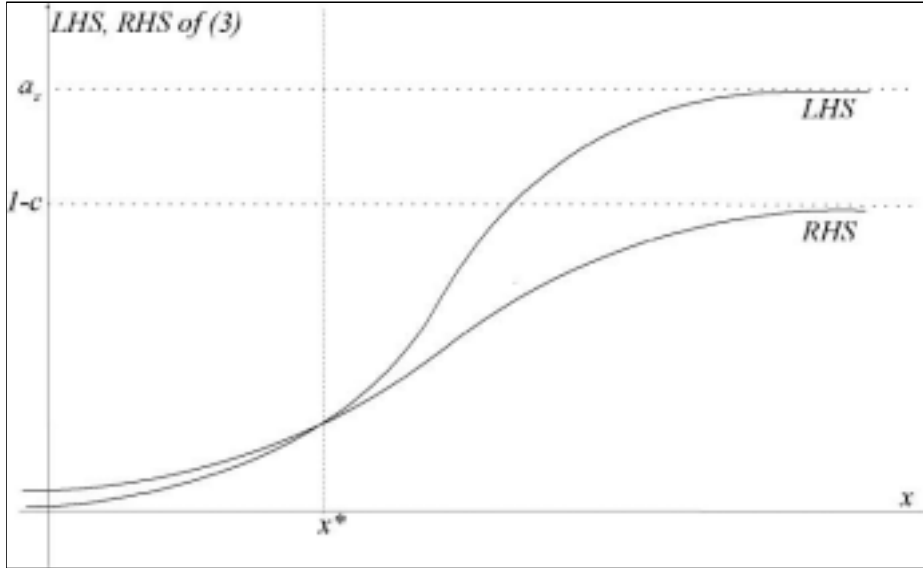


Figure 1: Suppliers' equilibrium strategy (x^*), given y^* .

In the following section we solve for the bank's equilibrium in trigger strategies. We show that for a given x^* there is a uniquely specified critical signal level (y^*) that determined the bank's equilibrium strategy. Yet, although there is an one-to-one relationship between x^* and y^* , that relationship turns out to be strictly decreasing when minimum tendering rates are set at a level lower than $F \frac{y^* - x^*}{\sigma}$. In other words, for $r < F \frac{y^* - x^*}{\sigma}$, we prove that equilibria of the type (x^*, y^*) are not unique.

5 Bank's Equilibrium in Trigger Strategies

Conditional on signal y , return \hat{R} is normally distributed with mean y and standard deviation v . For our base case where $\frac{v}{\sigma} \rightarrow 0$, we consider the following lemma:

Lemma 3 *Provided there is no liquidation at the interim date, and conditional on signal $y = y^*$, bank's belief about proportion l^b of suppliers rejecting the tender offer at $\tau = 1$ is given by: $l^b = F\left(\frac{x^* - y^*}{\sigma}\right)$.*

Proof. See Appendix ■

We now turn to solve for the bank's equilibrium in trigger strategies. We focus on the limiting case where $\frac{v}{\sigma} \rightarrow 0$.

5.1 Bank's equilibrium

Given that rejection by the bank would result in default by the firm and the bank would lose the original loan amount (B), bank's trigger point (y^*) solves the following equation:

$$-B \Pr\{\hat{R} < R^* \mid y = y^*\} - D \Pr\{R^* < \hat{R} < B + C + \alpha_s \mid 1 - l^b\} Q \mid y = y^* = -B \quad (4)$$

where, $D \equiv LGD \times (B + C)$ and, from section 3.2, $LGD > \frac{B}{B+C}$.

The first term on the LHS of (4) captures the conditional feature of bank's acceptance; should the bank agree to provide a new loan (C), but proportion of suppliers higher than the critical level ($1 - r$) rejects the offer, there is immediate default and the bank loses only the original loan amount (B). The second term captures the bank loss at the 'bad' situation where the bank loses more than B because of default at $\tau = 2$ and the additional credit (C) it extended at $\tau = 1$. In case of no-default at $\tau = 2$ the bank loses nothing. Should, however, the bank refuse to extend a new loan then it bears a certain loss of $-B$, which appears on the RHS of equation (4).

Proposition 2 *Given small creditors' equilibrium in trigger strategies x^* , if bank's acceptance to commit more funds (C) to the financially distressed firm is made conditional upon success of the tender offer to small creditors with minimum tendering rate r then, bank's equilibrium in trigger strategies (y^*) is given by:*

$$y^* = B + C + \alpha_s F\left(\frac{y^* - x^*}{\sigma}\right) Q - v F^{-1}\left(\frac{B}{D}\right) \quad (5)$$

where, from lemma (3), $1 - l^b = F\left(\frac{y^* - x^*}{\sigma}\right)$ and $D \equiv LGD \times (B + C)$ and, from section 3.2, the loss-given-default (LGD) is such that $LGD > \frac{B}{B+C}$.

Proof. See Appendix ■

From equation (5) we see that the higher the required amount of extra credit (C) and the higher the loss-given-default (LGD) that is associated with default at $\tau = 2$, the higher the bank's critical signal level y^* . Furthermore, the critical signal level y^* increases proportionately to the face value (α_s) of the new claims that are offered to the suppliers.

Equilibrium strategies by suppliers (x^*) and by the bank (y^*) can then be calculated by simultaneously solving equations (2) and (5), as well as equations (3) and (5). From proposition 1 we know that, for minimum tendering rates (r) higher than $F \frac{y^*-x^*}{\sigma}$, there is a uniquely determined suppliers' equilibrium (x^*) that depends only on the model parameters. By substituting that x^* from equation (2) into (5), and from the monotonicity of $F(\cdot)$, we derive a unique equilibrium in trigger strategies by the bank (y^*), as illustrated in the following figure:

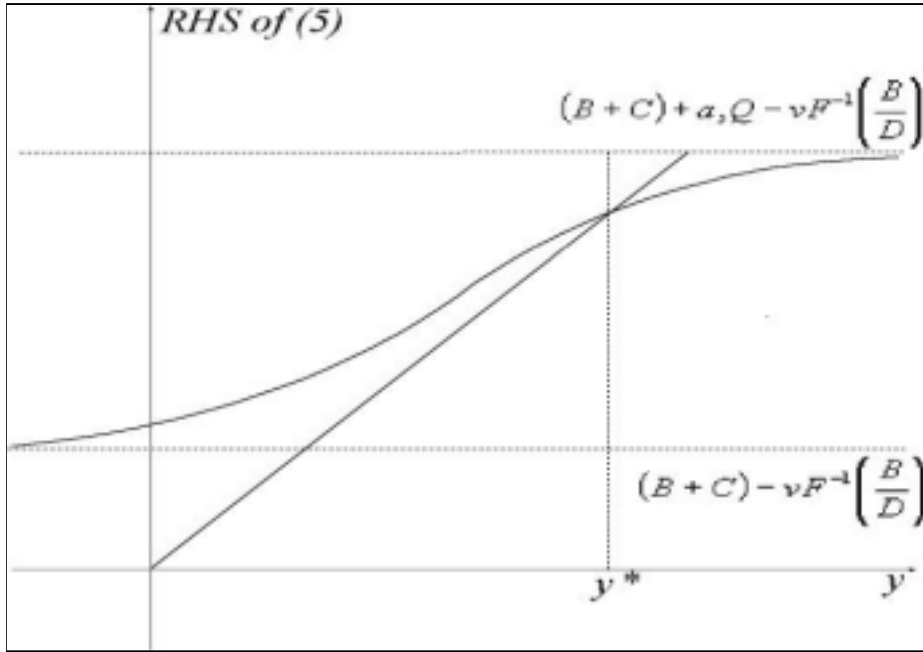


Figure 2: Bank's equilibrium strategy (y^*) for high r .

However, for minimum tendering rates (r) such that $r < F \frac{y^*-x^*}{\sigma}$, we substitute $F \frac{y^*-x^*}{\sigma}$ from equations (3) into (5) and we derive the following expression:

$$y^* = -\frac{a_s^2 Q}{(1-c)} F \frac{\tilde{A} x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} + a_s Q + (B+C) - v F^{-1} \frac{B}{D} \quad (6)$$

From equation (6) we observe that, for $r < F \frac{y^* - x^*}{\sigma}$, bank's equilibrium in trigger strategies (y^*) is defined as a strictly decreasing function of small creditors' equilibrium in trigger strategies (x^*). In other words, if one class of creditors attains a high equilibrium trigger strategies then, this is perceived as "good news" to the other class of creditors, which then chooses a low equilibrium in trigger strategies such that $r < F \frac{y^* - x^*}{\sigma}$, or $y^* > x^* + \sigma F^{-1}(r)$, and vice versa. This proves the following result:

Theorem 1 *If bank's acceptance to participate in the resolution of financial distress is made conditional upon success of a tender offer to small creditors with minimum tendering rate r , and if small creditors' equilibrium in trigger strategies is x^* while bank's equilibrium in trigger strategies is y^* then, for $r < F \frac{y^* - x^*}{\sigma}$ there are multiple equilibria in trigger strategies (x^*, y^*).*

A graphical representation of theorem 1 is shown in the following figure:

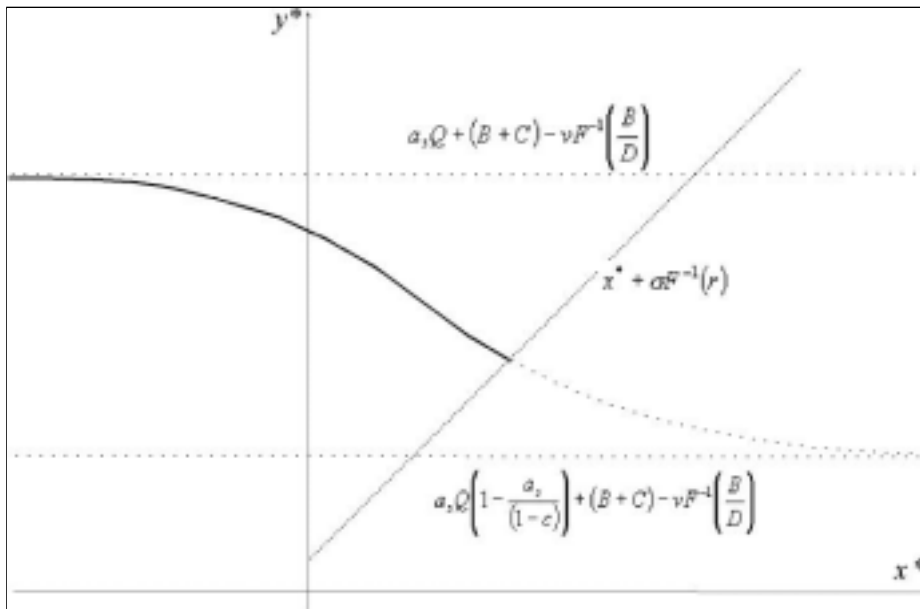


Figure 3: Multiple equilibria (x^*, y^*) for low r (bold line).

For a given level of the minimum tendering rate $r < F \frac{y^* - x^*}{\sigma}$, the locus of equilibria of the type (x^*, y^*) is the bold curve in figure 3. Nevertheless, in the following section we prove that all those equilibria are Pareto improving of a unique equilibrium in small claimants' strategies that we derive with no bank in the game.

5.2 No Bank in the Game

Let us now think of a situation where at date $\tau = 0$ a bank extends a senior and unsecured loan to the firm of total amount $B' = B + C$ for repayment at $\tau = 2$ and the fixed operating cost (C) is incurred at $\tau = 0$ (e.g. labour and other costs are paid up front). In that case, and similar to the above scenario where the bank provides a new loan at the intermediate date, suppliers who agree to extend credit to the firm will receive claims junior to the bank loan B' .

We assume, as previously, that suppliers follow trigger strategies around a critical signal level (x^{**}). There is no reason to expect x^{**} to be the same as x^* given that now suppliers are not able to learn from the action of the bank. Our objective is to compare x^{**} with x^* . The critical signal level (x^{**}) in that case solves the following equation:

$$\begin{aligned} & -c \Pr(R < R^{**} \mid x_i = x^{**}) - \\ & - \Pr(R^{**} < R < B' + a_s Q (1 - l^{**}) \mid x_i = x^{**}) + \\ & (a_s - 1) \Pr(R > B' + a_s Q (1 - l^{**}) \mid x_i = x^{**}) = -c \end{aligned} \quad (7)$$

where, $B' = B + C$, R^{**} is defined as in lemma (1) and l^{**} is defined as in lemma (2).

Proposition 3 *If there was no bank in the game then, under minimum tendering rate r , small creditors' equilibrium in trigger strategies (x^{**}) is given by:*

$$x^{**} = (B + C) + a_s Q \frac{\mu(1+r)}{2} + \sigma F^{-1} \frac{(1-r)(1-c)}{a_s} \quad (8)$$

Proof. See Appendix. ■

From equation (8), the critical signal level x^{**} is increasing in $(B + C)$ and Q (the leverage factors), and decreasing in c . The effects of a_s and r are ambiguous. It is worth noting that the sum of the first and second term on the RHS of (8) correspond to the representative-agent case where there is no strategic uncertainty about other agents' actions, while the third term corresponds to the strategic uncertainty premium, which can be either positive or negative depending on model parameters.

In particular, for minimum tendering rates (r) such that $r \leq \frac{2(1-c)-a_s}{2(1-c)}$ the strategic uncertainty premium is positive, otherwise it is negative, in which case we refer to it as a strategic-uncertainty discount. In the latter case, strategic agents rely substantially on what a successful tender offer implies with respect to the collective knowledge of other agents. Thus, they are ready to accept a discount in their signals before dropping an offer, given that they have nothing to lose by accepting an offer that subsequently fails (i.e. the minimum tendering rate is not met).

Finally, from equations (2) and (8) we observe that suppliers' equilibrium strategy x^{**} is the same as if there was a bank in the game and the minimum tendering rate (r) was relatively high. We are now ready to prove the following proposition:

Proposition 4 *If a bank accepts to participate in the resolution of financial distress of a debtor, and it does so conditional upon success of a tender offer to small creditors with minimum tendering rate r then, the equilibrium in small creditors' trigger strategies (x^*) is such that $x^* \leq x^{**}$, where equality holds only if the minimum tendering rate (r) is such that $r \geq F \frac{y^* - x^*}{\sigma}$, y^* is the equilibrium in bank's trigger strategies and x^{**} is the equilibrium in small creditors' trigger strategies when the bank is not in the game.*

Proof. See Appendix. ■

The following corollary results immediately from proposition 4.

Corollary 1 *For relatively low minimum tendering rates (r), in particular for $r < F \frac{y^* - x^*}{\sigma}$, acceptance by a bank to commit more funds to a financially distressed firm leads to contract revision offers becoming successful at a lower level of firm's fundamentals (R^*) compared to the situation with no bank involvement (R^{**}).*

Proof. It follows immediately from proposition 4 and the fact that $R^{**} = x^{**} - \sigma F^{-1}(1 - r)$ and $R^* = x^* - \sigma F^{-1}(1 - r)$. ■

Proposition 4 and corollary 1 imply that, controlling for money-effects, a bank's involvement in the resolution of financial distress of a debtor may induce small creditors to accept contract revision offers more easily, which is consistent with empirical evidence. As a result, a bank's involvement in debt restructuring may lead to lower deadweight costs of inefficient liquidation compared to the situation with no bank in the game. However, the results also suggest that if a bank's acceptance is made conditional upon relatively high minimum tendering rates by other creditors then, small creditors' equilibrium strategies turn out to be the same as if no bank was in the game. This is, excessive conditionality in bank's acceptance may negate the positive information externality of its involvement on other creditors.

6 Concluding Remarks

We developed a model of financial distress consistent with institutional characteristics of out-of-court renegotiation of a firm's contractual obligations. We investigated the extent to which acceptance by a well informed bank creditor to commit further to the financially distressed firm (i.e. via a new loan) facilitates contract revision offers that are made by the firm to a diffuse set of claimants.

Our results are consistent with empirical evidence, which suggests that banks play a potentially important role in facilitating the resolution of financial distress. In particular, when a bank participates in the debt restructuring, contract

revision offers become successful at lower values of the firm's fundamentals compared to the situation where the bank has no role to play in the restructuring. In that sense, involvement by a bank in a debt restructuring reduces the extent of inefficient liquidation due to potential co-ordination problems among creditors. However, the analysis suggests that excessive conditionality in the bank's acceptance to commit more funds to a financially distressed firm may negate the positive information externality of bank's acceptance on other creditors' actions. This is proved in proposition (4).

By drawing a parallel between the simple balance sheet of the financially distressed firm in our model, and the capital account of a country during the onset of a financial crisis, we may discuss possible implications of our analysis on the *doctrine of catalytic finance* regarding the resolution of an international financial crisis. That doctrine rests on the premise that, "under the right conditions", official assistance and private sector funding are strategic complements²⁴. Until before the Argentine crisis in 2001, the doctrine of catalytic finance was the cornerstone of the official community's strategy towards capital account crisis²⁵. The main idea was that official assistance to a country that experiences a liquidity crisis could encourage other creditors to act in a way that mitigates the crisis. Since the Argentine default, the doctrine of catalytic finance is less appealing among the G7. In particular, with respect to IMF interventions, there are voices nowadays arguing that the IMF's assistance to a country is exploited by private creditors and, in a sense, the two sources of funding become strategic substitutes during periods of financial crisis, rather than complements. Those voices are further reinforced by a moral-hazard story, according to which, the inability of the IMF to commit not always to intervene exacerbates the moral hazard problem on the part of the debtor country.

Given that our analysis relates to the work-outs of financial distress, rather than to the prevention of financial crisis, we could set aside the moral-hazard issue and conclude our discussion by noting the following: First, the presumption that underlies the doctrine of catalytic finance, namely, that official assistance to a country in financial crisis could encourage other creditors to act in a way that induces a more efficient resolution of the crisis, is in line with our result that the appropriate involvement of a *large* creditor may alleviate inefficiencies that possibly arise from co-ordination problems among creditors. Second, our analysis indicates that *excessive conditionality*, in a large creditor's acceptance of a restructuring offer, could work against the effectiveness of catalytic finance. In our model, that conditionality was captured through the minimum tendering rate. But it can also take other forms, such as assignment of *preferred creditor status (PCS)* to a large creditor, high tendering rates in *collective action clauses (CACs)* etc. But, it can also be the case that some degree of conditionality may permit creditors to make better informed decisions by allowing them to base their actions on the collective knowledge of other creditors. Thus, we may

²⁴See Morris and Shin (2003) for an elaborate analysis on catalytic finance..

²⁵The September 2000 communique of the International Monetary and Finance Committee states that "the combination of catalytic official financing and policy adjustment should allow the country to regain full market access quickly" .

conclude that conditionality in the provision of financial assistance should be a balancing act.

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7 Appendix

7.1 Proof of Lemma1

Conditional on actual investment return (R), signal x_i is normally distributed with mean R and variance σ^2 . Given that suppliers' signals $\{x_i\}$ are *iid*, the critical level of investment return (R^*), below which rejection by suppliers generates default, is such that:

$$\Pr(x < x^* \mid R = R^*) = 1 - r$$

That is,

$$F\left(\frac{x^* - R^*}{\sigma}\right) = 1 - r$$

or

$$R^* = x^* - \sigma F^{-1}(1 - r)$$

which proves the lemma.

7.2 Proof of Lemma2

Given that suppliers' signals are *iid*, conditional on no default at $\tau = 1$ (i.e. $R > R^*$) and on signal x_i , i supplier's belief about the proportion (l) of other suppliers receiving a signal lower than his is defined as follows:

$$l = \Pr(x_j < x_i \mid R > R^*) \quad (9)$$

For $x_i = x^*$ equation (9) gives the rejection rate (l^*) that one expects to occur when he observes a signal equal to the critical signal level (x^*):

$$\begin{aligned} l^* &= \Pr(x_j < x^* \mid R > R^*) = \\ &= \frac{\Pr(x_j < x^*, R > R^*)}{\Pr(R > R^*)} \end{aligned} \quad (10)$$

Conditional on signal $x_i = x^*$, signal x_j is normal with mean x^* and variance $2\sigma^2$. Similarly (R) is also normal with mean x^* and variance σ^2 . Moreover, conditional on $x_i = x^*$, x_j and R are correlated with covariance equal to σ^2 . Thus, (x_j, R) is a bivariate normal distribution with mean $\mu = (x^*, x^*)'$ and variance/covariance matrix $\Sigma = \begin{pmatrix} 2\sigma^2 & \sigma^2 \\ \sigma^2 & \sigma^2 \end{pmatrix}$. From the definition of the multivariate normal distribution and given that $\Sigma^{-1} = \frac{1}{\sigma^2} \begin{pmatrix} 1 & -1 \\ -1 & 2 \end{pmatrix}$ and $|\Sigma| = \sigma^4$, it is easy to show that l^* in equation (10) is given by the following expression:

$$l^* = \frac{\int_{-\infty}^{x^*} \int_{x^* - \sigma F^{-1}(1-r)}^{+\infty} \exp\left[-\frac{(x_j - R)^2 + (x^* - R)^2}{2\sigma^2}\right] dR dx_j}{1 - r} \quad (11)$$

By changing the order of integration in equation (11) and by applying the transformation $z = \frac{x_i - R}{\sigma}$, we get the following expression:

$$l^* = \frac{\frac{1}{\sqrt{2\pi\sigma^2}} \int_{x^* - \sigma F^{-1}(1-r)}^{+\infty} \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\frac{x^* - R}{\sigma}} \exp\left[-\frac{z^2}{2}\right] dz \exp\left[-\frac{(R-x^*)^2}{2\sigma^2}\right] dR}{1-r}$$

Let $w = \frac{R-x^*}{\sigma}$,

$$l^* = \frac{\frac{1}{\sqrt{2\pi}} \int_{-F^{-1}(1-r)}^{+\infty} \exp\left[-\frac{w^2}{2}\right] F(-w) dw}{1-r}$$

or

$$l^* = \frac{\int_{-F^{-1}(1-r)}^{+\infty} F(-w) f(w) dw}{1-r}$$

Let $w = -t$ and applying the fact that f is symmetric we finally get:

$$l^* = \frac{1}{2} \frac{\int_{-\infty}^{F^{-1}(1-r)} d[F(t)]^2}{1-r}$$

or

$$l^* = \frac{(1-r)}{2}$$

which proves the lemma.

7.3 Proof of Proposition 1

From equation (1) and using lemmas 1 and 2, we set $R^* = x^* - \sigma F^{-1}(1-r)$, $l^* = \frac{(1-r)}{2}$ and express R in terms of x_i . Then, the critical signal level x^* solves the following equation:

$$\begin{aligned} & \frac{\Pr\left\{\varepsilon_i > F^{-1}(1-r), \varepsilon_i - \frac{v}{\sigma}\varepsilon < \frac{x^* - y^*}{\sigma}\right\}}{\Pr\left\{\varepsilon_i - \frac{v}{\sigma}\varepsilon < \frac{x^* - y^*}{\sigma}\right\}} \\ & - \frac{\Pr\left\{\frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} < \varepsilon_i < F^{-1}(1-r), \varepsilon_i - \frac{v}{\sigma}\varepsilon < \frac{x^* - y^*}{\sigma}\right\}}{\Pr\left\{\varepsilon_i - \frac{v}{\sigma}\varepsilon < \frac{x^* - y^*}{\sigma}\right\}} + \\ & + (a_s - 1) \frac{\Pr\left\{\varepsilon_i < \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma}, \varepsilon_i - \frac{v}{\sigma}\varepsilon < \frac{x^* - y^*}{\sigma}\right\}}{\Pr\left\{\varepsilon_i - \frac{v}{\sigma}\varepsilon < \frac{x^* - y^*}{\sigma}\right\}} = -c \quad (12) \end{aligned}$$

For $\frac{v}{\sigma} \rightarrow 0$, equation (12) simplifies as follows:

$$\begin{aligned}
& -c \frac{\Pr \left\{ \varepsilon_i > F^{-1}(1-r), \varepsilon_i < \frac{x^* - y^*}{\sigma} \right\}}{\Pr \left\{ \varepsilon_i < \frac{x^* - y^*}{\sigma} \right\}} \\
& - \frac{\Pr \left\{ \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} < \varepsilon_i < F^{-1}(1-r), \varepsilon_i < \frac{x^* - y^*}{\sigma} \right\}}{\Pr \left\{ \varepsilon_i < \frac{x^* - y^*}{\sigma} \right\}} + \\
& + (a_s - 1) \frac{\Pr \left\{ \varepsilon_i < \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma}, \varepsilon_i < \frac{x^* - y^*}{\sigma} \right\}}{\Pr \left\{ \varepsilon_i < \frac{x^* - y^*}{\sigma} \right\}} = -c \quad (13)
\end{aligned}$$

We consider two cases: 1) $F^{-1}(1-r) < \frac{(x^* - y^*)}{\sigma}$ 2) $F^{-1}(1-r) > \frac{(x^* - y^*)}{\sigma}$.

Case 1: For $F^{-1}(1-r) < \frac{(x^* - y^*)}{\sigma}$ equation (13) becomes:

$$\begin{aligned}
& -c F \frac{x^* - y^*}{\sigma} - (1-r) - (1-r) - F \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} + \\
& + (a_s - 1) F \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} = -c F \frac{x^* - y^*}{\sigma}
\end{aligned}$$

or

$$x^* = (B+C) + a_s Q \frac{1+r}{2} + \sigma F^{-1} \frac{(1-r)(1-c)}{a_s}$$

which proves equation (2).

Case 2: For $F^{-1}(1-r) > \frac{(x^* - y^*)}{\sigma}$ equation (13) becomes:

$$\begin{aligned}
& -F \frac{x^* - y^*}{\sigma} + F \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} + \\
& + (a_s - 1) F \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} = -c F \frac{x^* - y^*}{\sigma}
\end{aligned}$$

or

$$a_s F \frac{x^* - (B+C) - a_s \frac{(1+r)}{2} Q}{\sigma} = (1-c) F \frac{x^* - y^*}{\sigma} \quad (14)$$

which proves equation (3) and completes the proof of the proposition.

7.4 Proof of Lemma 3

Conditional on no default at $\tau = 1$ (i.e. $R > R^*$) and on signal y^* , bank's belief about the proportion l^b of suppliers that receive a signal lower than x^* (i.e. reject firm's offer) is defined as follows:

$$l^b = \Pr(x_j < x^* \mid R > R^*, y = y^*) =$$

$$= \frac{\Pr(x_j < x^*, R > R^*)}{\Pr(R > R^*)} \quad (15)$$

Conditional on $y = y^*$ signal x_j is normally distributed with mean y^* and variance $v^2 + \sigma^2$. Similarly, return R is also normal with mean y^* and variance v^2 . Moreover, x_j and R are correlated with covariance v^2 . Thus, conditional on y^* , (x_j, R) is a bivariate normal distribution with mean $\mu = (y^*, y^*)'$ and variance/covariance matrix $\Sigma = \begin{pmatrix} v^2 + \sigma^2 & v^2 \\ v^2 & v^2 \end{pmatrix}$. From the definition of the multivariate normal distribution and the fact that $\Sigma^{-1} = \frac{1}{v^2\sigma^2} \begin{pmatrix} v^2 & -v^2 \\ -v^2 & v^2 + \sigma^2 \end{pmatrix}$ and $|\Sigma| = v^2\sigma^2$, it is easy to show that l^b in equation (15) is given by the following expression:

$$l^b = \frac{\int_{-\infty}^{x^*} \int_{x^* - \sigma F^{-1}(1-r)}^{+\infty} \exp\left[-\frac{(x_j - R)^2}{2\sigma^2} + \frac{(R - y^*)^2}{2v^2}\right] dR dx_j}{\Pr(y^* - v\varepsilon > x^* - \sigma F^{-1}(1-r))} \quad (16)$$

By changing the order of integration in equation (16) and by applying the transformation $z = \frac{x_j - R}{\sigma}$, we get the following expression:

$$l^b = \frac{\int_{-\infty}^{x^*} \frac{1}{\sqrt{2\pi v^2}} \exp\left[-\frac{(R - y^*)^2}{2v^2}\right] dR}{F\left(\frac{y^* - x^*}{v} + \frac{\sigma}{v} F^{-1}(1-r)\right)}$$

or

$$l^b = \frac{\int_{-\infty}^{x^*} \frac{1}{\sqrt{2\pi v^2}} \exp\left[-\frac{(R - y^*)^2}{2v^2}\right] dR}{F\left(\frac{y^* - x^*}{v} + \frac{\sigma}{v} F^{-1}(1-r)\right)}$$

Let $w = \frac{R - y^*}{v} \Rightarrow R = vw + y^*$,

$$l^b = \frac{\int_{-\infty}^{x^* - y^* - \sigma F^{-1}(1-r)} \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{w^2}{2}\right] dw}{F\left(\frac{y^* - x^*}{v} + \frac{\sigma}{v} F^{-1}(1-r)\right)}$$

or

$$l^b = \frac{\int_{-\infty}^{x^* - y^* - \sigma F^{-1}(1-r)} f(w) dw}{F\left(\frac{y^* - x^*}{v} + \frac{\sigma}{v} F^{-1}(1-r)\right)} \quad (17)$$

Equation (17) can be simplified a lot by considering the limiting case where $\frac{v}{\sigma} \rightarrow 0$ ($\frac{\sigma}{v} \rightarrow \infty$). This is,

$$l^b = F\left(\frac{x^* - y^*}{\sigma}\right) \quad (18)$$

which proves the lemma.

7.5 Proof of Proposition 2

By substituting R^* from lemma (1) into equation (4) and expressing \mathbb{R} in terms of bank's signal (y) we get the following equation:

$$-B \Pr \left[\varepsilon > \frac{y^* - x^*}{v} + \frac{\sigma}{v} F^{-1}(1-r) \right] - \tilde{A} \frac{y^* - B - C - a_s (1-l^b) Q}{v} < \varepsilon < \frac{y^* - x^* + \sigma F^{-1}(1-r)}{v} = -B \quad (19)$$

The critical signal levels x^* and y^* are found by solving simultaneously equations (12) and (19). Obviously neither of these equations can be solved in closed form in the general case, though they can be solved numerically. We consider, however, the limiting case where $\frac{\sigma}{v} \rightarrow 0$. In that case, equation (19) becomes:

$$F \frac{\tilde{A} (B + C - y^* + a_s (1-l^b) Q)}{v} = \frac{B}{D}$$

or

$$y^* = B + C + a_s F \frac{y^* - x^*}{\sigma} Q - v F^{-1} \frac{B}{D}$$

which proves the proposition.

7.6 Proof of Proposition 3

By substituting $R^{**} = x^{**} - \sigma F^{-1}(1-r)$ and $l^{**} = \frac{(1-r)}{2}$ in equation (7) we get the following equation:

$$-c + c(1-r) - (1-r) + a_s F \frac{\tilde{A} (x^{**} - (B+C) - a_s Q \frac{1+r}{2})}{\sigma} = -c$$

or

$$a_s F \frac{\tilde{A} (x^{**} - (B+C) - a_s Q \frac{1+r}{2})}{\sigma} = (1-c)(1-r) \quad (20)$$

or

$$x^{**} = (B+C) + a_s Q \frac{1+r}{2} + \sigma F^{-1} \frac{(1-c)(1-r)}{a_s} \quad (21)$$

which proves the proposition.

7.7 Proof of Proposition 4

From proposition (1) and for $r < F \frac{y^* - x^*}{\sigma}$, namely $F^{-1}(1-r) > \frac{x^* - y^*}{\sigma}$, a small claimants' critical signal level (x^*) satisfies the following expression:

$$a_s F \frac{\tilde{A} (x^* - (B+C) - a_s Q \frac{1+r}{2})}{\sigma} = (1-c) F \frac{y^* - x^*}{\sigma} \quad (22)$$

If there was no bank in the game then, from proposition (3) we know that a small claimants' critical signal level (x^{**}) solves the following equation:

$$a_s F \frac{\tilde{A} x^{**} - (B + C) - a_s Q i \frac{1+r}{2}}{\sigma} = (1 - c)(1 - r) \quad (23)$$

Given $F^{-1}(1 - r) > \frac{x^* - y^*}{\sigma}$, or $F \frac{x^* - y^*}{\sigma} < (1 - r)$, equations (22) and (23) imply the following inequality:

$$F \frac{\tilde{A} x^* - (B + C) - a_s Q i \frac{1+r}{2}}{\sigma} < F \frac{\tilde{A} x^{**} - (B + C) - a_s Q i \frac{1+r}{2}}{\sigma} \quad (24)$$

From the monotonicity of $F(\cdot)$, inequality (24) holds if and only if $x^* < x^{**}$. For $r > F \frac{y^* - x^*}{\sigma}$, propositions 1 and 3 imply that $x^* = x^{**}$, which completes the proof of the proposition.