Product Market Interactions and the Propensity to Restructure in Bankruptcy

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Abstract

In this paper we model the spillovers from the restructuring of a financially distressed firm on other firms and the feedback effects from the restructuring. Our results indicate that the spillover and feedback effects are complex and are determined by several factors including the level of information asymmetry regarding the restructuring firm, its direct bankruptcy cost, bankruptcy’s effect on its competitiveness, and the nature of its economic linkages with the other firms. For example, when the information asymmetry about a firm’s prospects is sufficiently high, its bankruptcy can lower both its competitor’s stock price and the probability that the competitor will restructure in bankruptcy, while raising the price of its competitor’s debt. A sufficiently large decline in the level of information asymmetry can cause these price and bankruptcy probability effects to reverse. Switching from competitive to a customer-supplier relationship also reverses the price and bankruptcy probability spillover effects.

JEL Classification Codes: G33; Keywords: restructuring, distress, spillover, feedback

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We thank seminar participants at UT Dallas for comments. We alone are responsible for all errors.
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Abstract

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1 Introduction

Information asymmetry between a distressed firm’s claimants can make its restructuring contentious (Wruck (1990); Giammarino (1989)). A contentious restructuring can disrupt the firm’s operations and force it into bankruptcy (Giammarino (1989)). Moreover, developments during the restructuring can signal the claimants’ private information. Both the operating disruptions and the information signaled during restructuring can affect the firm’s customers, suppliers, and competitors, who are often themselves distressed and restructuring.1 Several empirical studies have examined the spillover effects of corporate restructurings on the security prices and operating performance of economically linked firms, e.g., supplier, customer, and competitor firms (see, for example, Lang and Stulz (1992), Iqbal (2002), Herzel, Officer, and Rogers (2008)). While these studies uniformly find evidence of economically significant spillover effects on customer, supplier, and competitor firms, there exists no theoretical model of these effects. The need for such a model is especially important since these studies often contain contradictory evidence regarding the direction of the spillover effects.2

In this paper, we develop a model to fill this void. Our results provide both a context within which to interpret empirical evidence on the effects of a firm’s restructuring on economically linked firms, and a guide for future empirical research in this area. Specifically, we model two firms that are forced to renegotiate their debt contracts because they are financially distressed. Each firm has information about its competitiveness and thus, its value. This information is private and thus, it is not observed by other agents including the firm’s debtholder. The firms can try to restructure their claims outside bankruptcy. However, if the negotiation between a firm and its debtholder breaks down, the restructuring is completed in bankruptcy. The operational disruption caused by a breakdown in negotiations and the ensuing bankruptcy erode a firm’s competitiveness.3 How this affects the second firm depends on their economic relationship. Initially, we

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1Industry-wide distress is fairly common, and has been studied in the literature both theoretically and empirically (Shleifer and Vishny (1992), Acharya, Bharath, and Srinivasan (2007)). Recent examples include the solar power industry (“Solyndra Bankruptcy Reveals Dark Clouds in Solar Power Industry” By Anne C. Mulkern) and retail industry (“Factbox: Recent Retail Bankruptcies,” Reuters). Simultaneous financial distress of suppliers is discussed, for example, in Benmelech, and Bergman (2008). The automobile industry and its suppliers have also faced financial distress in recent years (see, for example, “The American Automotive Industry Supply Chain? In the Throes of a Rattling Revolution,” at trade.gov/static/auto_reports_supplychain.pdf - 2011-05-29).

2For example, Lang and Stulz (1992) find that a bankrupt firm’s competitors lose market value if the industry is highly levered or intra-industry returns highly correlated, but enjoy an increase in market value in highly concentrated industries with low leverage. In contrast, Iqbal (2002) finds that bankrupt firms’ competitors enjoy a higher return on equity in industries with both high and low leverage, and stock return correlation.

3For example, the article “Does the Worldcom Bankruptcy Put My Telecom Service at Risk?” by Harrison notes that “During restructuring, senior management will be preoccupied with maintaining financial viability, not maintaining or improving customer service...Fewer people will be available to answer questions, resolve problems, and correct billing and order processing...
assume that the firm’s are competitors and thus, each firm benefits from disruptions of the other firm’s operations and the resulting erosion in its competitiveness. Later, to highlight how restructuring-related spillovers are dependent on the nature of the economic relation between firms, we switch to assuming the firms share a customer-supplier relationship and thus, each firm is hurt by disruptions of the other firm’s operations. To highlight the effect of the nature of bankruptcy on restructuring-related spillovers, we also examine the impact of restructurings when firms can use the protection of bankruptcy to strengthen their competitive positions.\footnote{Bankruptcy can strengthen a firm’s competitive position in several ways. For example, it can help reduce the firm’s costs by having the Pension Benefit Guaranty Corporation (PBGC) take over pension obligations. A firm can also employ bankruptcy protection to renegotiate its labor contracts. For example, following its bankruptcy GM’s labor costs fell to $50 per hour compared with $72 before its bankruptcy and Ford’s labor costs of $55 (source: “UAW Anger at Contract Concessions on the Rise” By Joseph R. Szczesny, Tuesday, Feb. 23, 2010). Roe and Skeel (2009) argue that bankruptcy protection allowed Chrysler to execute a turnaround strategy that would not have been possible outside bankruptcy.}

Our results demonstrate that a firm’s restructuring can exert complex spillover effects that move the equity and debt prices of linked firms, and influence their restructuring outcomes. These spillover effects also feed back to the firm’s own restructuring. The spillover and feedback effects are complex because a firm’s restructuring exerts two forces on linked firms and each of these forces is, in turn, determined by several of the following factors: the extent to which bankruptcy erodes a firm’s competitiveness, the size of direct bankruptcy costs, the level of information asymmetry between the firm and its debtholder, and the nature of economic linkages between firms.

The first force exerted by a firm’s restructuring on a linked firm, which we refer to as the \textit{competitiveness effect}, is transparent. If a firm’s restructuring is contentious and completed in bankruptcy, it becomes less competitive. This directly benefits a competitor but hurts a supplier or customer. The strength of the competitiveness effect, which is determined by the extent to which bankruptcy erodes competitiveness, determines the competitor’s (supplier’s or customer’s) gain (loss). The second force, which we refer to as the \textit{information effect}, is more subtle. In equilibrium, a low restructuring offer is more likely to be made by a strong firm. However, a low offer is also more likely to be overvalued since a weak firm will try to exploit its information advantage to secure “concessions” by making a low offer. Therefore, the debtholder is more likely to challenge a low offer, ensuring that a strong firm is more likely to restructure in bankruptcy. Consequently, a firm’s bankruptcy signals bad news for a competitor and good news for a customer or supplier. The fidelity of this signal and thus, the strength of the information effect, is a function of extent to which bankruptcy erodes competitiveness, the size of direct bankruptcy costs, and the level of information mistakes...Worldcom is likely to suffer a talent drain as the company restructures.”
asymmetry between the firm and its debtholder.

The relative strengths of the competitiveness and information effects determine the spillover from a restructuring. If the competitiveness effect is stronger, a competitor will be in a stronger position if a firm restructures in bankruptcy than if it restructures outside bankruptcy. Therefore, the competitor’s share price will rise following news of the firm’s bankruptcy. If the competitor also files for bankruptcy, its cannot fully exploit the firm’s weakness. Therefore, the firm’s bankruptcy also raises the competitor’s bankruptcy cost which discourages the competitor’s debtholder from rejecting low restructuring offers. The competitor responds to the debtholder’s more accommodating stance by seeking concessions more aggressively if it is weak. The latter effect dominates, raising the likelihood that the competitor will restructure in bankruptcy. Since the debtholder shares in the cost of the firm’s bankruptcy but does not enjoy a commensurate benefit from its higher profitability, the price of the competitor’s debt falls on news of the firm’s bankruptcy. These price and bankruptcy spillover effects tend to reverse when the information effect becomes stronger than the competitiveness effect.

The spillovers change with the nature of the firms’ economic relationship. The directions of the competitiveness and information effects reverse when, instead of being competitors, the firms share a customer-supplier relationship; the erosion of a firm’s competitiveness due to bankruptcy lowers the profit of a supplier (customer), while its bankruptcy, which signals that it is strong, is good news for a supplier (customer). Therefore, when the competitiveness effect is stronger then the information effect, a supplier (customer) firm will be in a weaker position if the firm restructures in bankruptcy rather than outside bankruptcy. The supplier’s (customer’s) weaker position will result in a lower share price, a higher price for its debt, and a lower bankruptcy probability. The debt price and bankruptcy effects are based on the argument above. These effects reverse, when the information effect becomes stronger than the competitiveness effect.

The spillovers also change with the nature of bankruptcy. Instead of eroding a firm’s competitiveness, bankruptcy may allow the firm to restructure its operations and emerge as a stronger competitor. If so, the competitiveness effect of bankruptcy is reversed; a firm’s bankruptcy will hurt a competitor and help a supplier or customer. Consequently, the information effect of bankruptcy, instead of countering its competitiveness effect, will complement it. Therefore, regardless of the level of information asymmetry about a firm, when it restructures in bankruptcy, a competitor’s (customer/supplier’s) profitability will deteriorate (improve) and its share price will fall (rise).

The feedback from a restructuring depends on the nature of the bankruptcy cost incurred by firms.
When the erosion of a firm’s competitiveness is the only cost of bankruptcy, a feedback effect exists only for a narrow set of parameters. The feedback effect is limited because, while the spillover effect from one firm’s restructuring influences the likelihood that the second firm will restructure in bankruptcy, it does not generally alter the expected competitiveness of the second firm. To see this, consider, for example, the case where two firms are competitors and the competitiveness effect is stronger than the information effect of restructuring. As we have explained earlier, following a firm’s bankruptcy, its competitor’s debtholder will adopt a more accommodating stance but the equityholder will seek concessions more aggressively. Consequently, a firm’s bankruptcy raises the likelihood that its competitor will restructure in bankruptcy if it is weak and outside bankruptcy if it is strong. For most parameter values, these opposing effects exactly offset each other, leaving the competitor’s expected competitiveness unchanged. Direct bankruptcy costs, that result in a deadweight loss to the firm but do not affect its competitiveness, upset this delicate balance. Therefore, when a firm also faces direct bankruptcy costs, the feedback effect from a restructuring becomes pervasive. However, the feedback effect is weak.

There are several models of distress-induced restructuring. For example, Mooradian (1994) and White (1994) model the choice between restructuring under the protection of Chapter 11 of the bankruptcy code (reorganization) and liquidation in Chapter 7 of the bankruptcy code. More recently, several studies have examined restructuring and liquidation without formally incorporating a role for bankruptcy (Broadie, Chernov and Sundaesran (2007), Elkamhi and Jiang (2011)). In contrast, Gertner and Scharfstein (1991) and Giammarino (1989) identify factors that determine why debt negotiations may be unsuccessful and restructuring firms often resort to a costly bankruptcy. Gertner and Scharfstein (1991) links bankruptcy with the ownership structure of debt, while Giammarino (1989) demonstrates that bankruptcy may be caused by asymmetric information between the firm’s claimants. Our analysis is closest to Giammarino (1989) since we model bankruptcy in an identical fashion. Moreover, to focus on the information conveyed by restructuring outcomes, like Giammarino (1989), we assume that firms’ claimants are asymmetrically informed.

We depart from these models by focusing on the spillovers of a firm’s restructuring on other firms rather than on the payoffs of its own claimants. Moreover, to keep our analysis tractable and abstract from the freerider problem between a firm’s debtholders highlighted by Gertner and Scharfstein (1991), we assume that each firm’s debt is owned by a single claimant who internalizes the entire effect of any restructuring outcome. We do not explicitly consider a role for firm liquidation. However, the effect of liquidation can easily be accommodated in our analysis; liquidation is an extreme case of lost competitiveness and renders
the information effect of bankruptcy irrelevant.

In our model, a firm’s bankruptcy can influence the probability that a related firm will also restructure in bankruptcy. This correlation between firms’ bankruptcies arises only because the firms’ operate in the same (related) market(s) and because bankruptcy conveys information about the value of their altered relationship. In contrast, several papers have demonstrated that common ownership of debt or trading links between debtholders can forge links between the firms’ restructurings. For example, Diamond and Rajan (2005) demonstrate that a bank may choose to force some debtors to restructure their loans if the performance of its loans to other debtors fails to meet its expectations. An increase in the bank’s interest cost increases the strength of this relationship between unmet expectations and restructuring. Acharya and Viswanathan (2009) extend Allen and Gale’s (2000) model to demonstrate that trading links between lenders can magnify crises where firms are forced to liquidate and restructure.

Our paper is also related to the large literature that focuses on the effect of leverage on a firm’s competitive position/profitability. Brander and Lewis (1986), Maksimovic (1988), and Bolton and Scharfstein (1990) are classical papers in this literature; Povel and Raith (2004) is a recent example. Like these papers, we also examine the effect of financial decisions made by firms operating in an oligopolistic output market on their competitive position/profit. However, instead of examining the effect of the level of indebtedness, we focus on firms’ restructuring choices. A key difference between our model and the modeling approach adopted in this literature is that, in our model, firms’ restructuring outcomes signal private information. Therefore, both the direct effect of a firm’s choice on its competitiveness and the information it signals about its strength affect its competitor’s decisions.

The remainder of this paper is organized as follows: In Section 2, we develop our model. Section 3 contains derivations of the equilibrium outcomes for each firm. In Section 4, we describe the spillover and feedback effects of restructurings. Section 5 contains an analysis of changes in our results when we vary assumptions regarding the the economic linkages between firms and the nature of bankruptcy costs. In Section 6 we introduce and discuss novel empirical predictions arising from our model. We conclude the paper with a summary of our findings in Section 7.
2 Model

We consider a three-period economy populated by risk-neutral agents and a risk-free rate of zero. Two levered firms compete in a product market. Firm \( j \in \{1, 2\} \) has outstanding debt \( D_j \) due in period \( i \). Each firm is owned and managed by a single equityholder. To simplify the exposition, we identify each equityholder with her firm. Each firm’s debt is private and is held by a single debtholder.\(^5\) Neither firm has cash to pay its debt. However, in period three, firm \( j \) can generate cash flow \( \Pi_j \) that depends on its ability to compete. A firm’s ability to compete is uncertain and independent of its competitor’s ability to compete. Let firm \( j \)’s ability to compete in period three be represented by \( c_j \in \{y, n\} \), where \( y \) denotes that the firm is competitive and \( n \) denotes that it is not. Firm \( j \)’s period three cash flow, \( \Pi_j = \pi_j > 0 \) when \( c_j = y \). To simplify the analysis, if firm \( j \) is not competitive in period three, we normalize its cash flow to zero, i.e., \( \Pi_j = 0 \) when \( c_j = n \). At the beginning of period one, each firm privately observes a signal informing it of its type, \( t \in \{s, w\} \), where \( s \) signals it is strong and \( w \) signals it is strong. If firm \( j \) observes signal \( t \), it will be competitive with probability \( \phi^t_j \), where \( \phi^w_j < \phi^s_j \). The prior probability that firm \( j \) observes the signal \( s \) indicating it is strong is \( q_j \in [0, 1] \). This prior is common knowledge.

Since neither firm has cash to pay its debt, each firm must renegotiate its debt when it comes due. Therefore, firm one renegotiates in period one and firm two renegotiates in period two, after the completion of firm one’s renegotiation. The structures of the two renegotiations are identical. Firm \( j \) begins its renegotiation by offering to exchange its outstanding debt claim, \( D_j \), for a new debt claim that will pay \( \hat{D}_j \) at the end of period three.\(^6\) The debtholder can either accept or reject the offer. If the debtholder accepts, the restructuring is complete; the debtholder receives \( \min\{\hat{D}_j, \Pi_j\} \) at the end of period three and the firm retains the residual cash flow. If the debtholder rejects, the firm enters bankruptcy. In bankruptcy, the court imposes a division of cash flows (a restructuring plan) that completes the restructuring. Let \( b_j \) indicate whether firm \( j \) restructures in bankruptcy, where \( b_j = i \) if it does, and \( b_j = o \) otherwise.

Following Giammarino (1989), we assume that, in bankruptcy, the debtholder and the bankruptcy court learn the firm’s type, i.e., the firm’s information advantage vis a vis the debtholder is dissipated. This assumption reflects the idea that participants in a restructuring learn about the firm during the valuation

\(^5\)We assume only one equityholder and one debtholder for each firm to simplify the analysis and permit us to abstract from issues related to coordination between claimants during negotiations and asymmetric information problems that might arise when claimants own claims on both firms.

\(^6\)It is convenient to assume that the new claim is also debt. Our results are qualitatively unchanged if we modify this assumption to allow the firm to offer some mix of debt and equity.
hearings in bankruptcy. Firm two and its debtholder can observe whether or not firm one enters bankruptcy before they begin their negotiation in period two. However, to simplify the analysis and to highlight the primary tradeoffs underlying the model, we assume that firm two’s claimants and bankruptcy court cannot observe firm one’s valuation hearings or its type until after firm two’s debt renegotiating is complete.\footnote{This is equivalent to assuming that participants in firm two’s restructuring do not participate in firm one’s restructuring and that there is a delay between the completion of firm one’s bankruptcy and the release of information from its valuation hearing to agents who do not participate in the restructuring. We make this assumption to simplify the exposition. Loosening this assumption results in our having to develop additional notation to characterize the restructuring of firm two for several more cases corresponding to each possible (type-contingent) outcome of firm one’s restructuring. However, the basic insights we develop are unaffected. In fact, in an earlier draft of this paper we demonstrate that the spillover and feedback effects of firm one’s restructuring we develop below are virtually identical to the average effects of firm one’s restructuring in the absence of this assumption. The proofs are available from the authors upon request.} Let $\mathcal{I}_j$ represent public information regarding its competitor’s negotiation at the time firm $j$ starts negotiating with its debtholder. Then, $\mathcal{I}_2 = b_1$ since firm one’s bankruptcy status is public information when firm two begins its negotiation. When firm one begins its negotiation, there is no public information about firm two’s restructuring. Therefore, $\mathcal{I}_1 = \emptyset$.

Bankruptcy erodes a firm’s competitiveness.\footnote{In practice, the erosion of the firm’s competitiveness arises from constraints that bankruptcy procedures and litigation between a firm and its debtholders following their disagreement place on management, the reluctance of suppliers to deal with a firm if it is disputing creditors’ claims, and the departure of employees who prefer to work for a firm with a less uncertain future.} Therefore, the firm’s period three cash flow will fall when it is forced into bankruptcy. The extent of the decline is determined by its competitors’ restructuring and ability to compete. Specifically, firm $j$’s period three cash flow is a function of its restructuring outcome ($b_j$), its competitor’s restructuring outcome ($b_k$), and its competitor’s ability to compete ($c_k$), and can be represented as follows:

$$
\Pi_j = \begin{cases} 
0 & \text{if } c_j = n, \\
\pi_j(b_j, b_k, c_k) & \text{if } c_j = y
\end{cases}
$$

(1)

where

$$
\pi_j(i, b_k, c_k) < \pi_j(o, b_k, c_k).
$$

(2)

To simplify the analysis and limit the number of cases we have to consider, we assume that, despite the dissipation of cash flows with bankruptcy, the expected value of each firm’s period three cash flow is always
greater than its outstanding debt, i.e.,

$$\min_{b_k, c_k} \phi^w_j \pi_j(i, b_k, c_k) > D_j.$$  \hfill (3)

As in Giammarino (1989), the bankruptcy court imposes a “fair” restructuring plan by shifting the cost of bankruptcy to the debtholder (equityholder) if the firm’s original offer is judged to be fair (unfair).\(^9\) The fairness of the firm’s original offer is judged based on its type, which is revealed during its bankruptcy. Based on Assumption (3), if firm \(j\) is type \(t\), a fair offer \(F_t^j\) satisfies

$$F_t^j = D_j / \phi^t_j.$$  \hfill (4)

Note that \(F_t^j < F_w^j\). If the firm’s offer is worth less than the outstanding debt, \(D_j\), i.e., \(\hat{D}_j < F_t^j\), the entire bankruptcy cost is shifted to the firm by making it exchange its debt for a new claim with a face value \(F_t^j\). This ensures that the debtholder’s expected payoff is \(D_j\). If, however, the firm’s original offer, \(\hat{D}_j\), is worth at least as much as \(D_j\), the entire cost of bankruptcy is transferred to the debtholder, who receives a claim with a face value of \(D'_j\), where

$$E \left[ \max \{ \Pi_j - F_t^j, 0 \} | t_j, b_j = o, \mathcal{I}_j \right] = E \left[ \max \{ \Pi_j - D_j', 0 \} | t_j, b_j = i, \mathcal{I}_j \right],$$  \hfill (5)

ensuring that the firm’s payoff is not changed by bankruptcy.

The structure of the market in which the firms operate determines the extent to which a firm’s bankruptcy affects its competitor. We adopt a fairly general market structure and only a few impose intuitive restrictions. First, we assume that firm \(j\)’s cash flow is highest when firm \(k\) is unable to compete (\(c_k = n\)) and is lowest when firm \(k\) is able to compete and its competitiveness has not been eroded by bankruptcy, i.e.,

$$\pi_j(b_j, b_k, n) > \pi_j(b_j, i, y) > \pi_j(b_j, o, y).$$  \hfill (6)

We also assume that a firm’s opportunity cost from bankruptcy-induced lost competitiveness, the profit it loses when because of its bankruptcy, is largest when its competitor is weakest.\(^10\) Specifically, let \(\Delta^{b_k}_j\) and

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\(^9\)As explained by Giammarino (1989), this cost structure limits frivolous litigation.

\(^10\)This is likely to be the case if management flexibility and attention to the firm’s operations, uninterrupted supplies, and retention of employees are most profitable when competition is weak.
\( \Delta_j^o \) capture the effect of firm \( j \)'s bankruptcy on its cash flow when firm \( k \) can compete and not compete, respectively, i.e.,

\[
\Delta_{jk}^b \equiv \pi_j(o, b_k, y) - \pi_j(i, b_k, y);
\]
\[
\Delta_j^n \equiv \pi_j(o, b_k, n) - \pi_j(i, b_k, n).
\]

(7)

We assume that

\[
\Delta_j^n > \Delta_j^i > \Delta_j^o.
\]

(8)

We solve for Bayesian Nash Equilibria of this game. In these equilibria, each firm makes an initial re-structuring offer that maximizes its expected share value given the strategies of its debtholder, the competing firm, and the competing firm’s debtholder. Each firm’s debtholder’s response to the initial offer maximizes his expected payoffs given the initial offer by the firm and the strategies of the competing firm and the competing firm’s debtholder. When possible, beliefs are updated using Bayes rule.

3 The equilibria

Each firm will try to exploit its information advantage to get its debtholder to agree to a restructuring that pays him less than he is owed, i.e., a type \( t \) firm will try to get the debtholder to accept a promised payment lower than \( F^s_j \). Since an offer lower than \( F^s_j \) is unfair regardless of firm \( j \)'s type, firm \( j \)'s debtholder can guarantee himself full repayment by forcing the firm into bankruptcy if it offers less than \( F^s_j \). Therefore, a strong (type \( s \)) firm cannot obtain concessions. Since a firm has no incentive to top a fair offer, a strong firm will always offer exactly \( F^s_j \).

In contrast, a weak (type \( w \)) firm may be able to secure concessions. To succeed, it has to be able to keep its type hidden from its debtholder. It can do so by offering the same payment as a strong firm, \( F^s_j \). Suppose that a weak firm makes the restructuring offer of \( F^s_j \) with a probability of \( e_j \). Since a strong firm makes this offer with probability one, by Bayes rule, the conditional probability that offer \( F^s_j \) is made by type \( s \) is given by \( \frac{q_j}{q_j + (1-q_j)e_j} \). Therefore, the debtholder’s expected loss from accepting such an offer equals

\[
D_j - \left( \frac{q_j}{q_j + (1-q_j)e_j} D_j + \left( 1 - \frac{q_j}{q_j + (1-q_j)e_j} \right) \phi^w F^s_j \right) = \frac{(1-q_j)e_j}{q_j + (1-q_j)e_j} \ell_j D_j,
\]

(9)
where $\ell_j$ represents the likelihood ratio $(\phi^s - \phi^w)/\phi^s$. Recognizing that he will suffer the mispricing loss captured in (9) if he accepts a restructuring offer of $F_j^s$, a debtholder may reject such an offer, forcing the firm into bankruptcy. The debtholder’s willingness to reject the offer is determined by the bankruptcy cost he expects to bear if the firm turns out to be type $s$. Let $\Delta_j(\mathcal{I}_j)$ represent the expected bankruptcy-induced decline in firm $j$’s cash flow conditioned on the public information $\mathcal{I}_j$, i.e.,

$$
\Delta_j(\mathcal{I}_j) = E[\pi_j(o, b_k, c_k) - \pi_j(i, b_k, c_k)|\mathcal{I}_j].
$$

(10)

Then, the debtholder’s expected bankruptcy cost if he rejects an offer of $F_j^s$ is given by

$$
q_j \phi^s j \Delta_j(\mathcal{I}_j).
$$

(11)

When this cost is sufficiently large, the debtholder will always agree to an offer of $F_j^s$, and there will only exist equilibria in which the firm restructures outside bankruptcy. In these equilibria, firm $j$ offers $F_j^s$ regardless of its type and its debtholder accepts the offer. When the debtholder’s bankruptcy cost is small, however, the firm may be forced to restructure in bankruptcy. As we demonstrate in the following proposition, in this second set of equilibria, type $w$ attempts to obtain concessions by randomly offering either $F_j^s$ or $F_j^w$. The debtholder always accepts an offer of $F_j^w$ but randomly reject offers of $F_j^s$. To help with exposition, when analyzing outcomes for a given firm, we refer to an equilibrium in which there is a zero ex ante probability that the firm will enter bankruptcy as out-of-bankruptcy equilibrium, and an equilibrium in which there is positive probability that the firm will enter bankruptcy as a bankruptcy equilibrium.

**Lemma 1.** In all equilibria, firm $j$ and its debtholders use one of the following two sets of strategies:

1. Out-of-bankruptcy-equilibrium: Regardless of its type, firm $j$ offers its debtholder $F_j^s$ and the debtholder accepts the offer. This equilibrium occurs only if bankruptcy has a sufficiently large impact on firm $j$’s expected cash flows, i.e.,

$$
q_j \phi^s j \Delta_j(\mathcal{I}_j) > (1 - q_j) \ell_j D_j.
$$

(12)

2. Bankruptcy equilibrium: Firm $j$ always offers $F_j^s$ if it is type $s$. If firm $j$ is type $w$, it tries to obtain
concessions from its debtholder by offering $F_j^s$ with probability:

$$e_j(\mathcal{J}_j) = \frac{q_j \phi_j^s \Delta_j(\mathcal{J}_j)}{(1 - q_j) \ell_j D_j},$$  

(13)

and making a fair offer of $F_j^w$ otherwise. The debtholder always accepts an offer of $F_j^w$, but rejects an offer of $F_j^s$ with probability $d_j(\mathcal{J}_j)$, where:

$$d_j(\mathcal{J}_j) = \frac{\ell_j D_j}{\phi_j^w \Delta_j(\mathcal{J}_j) + \ell_j D_j}.$$  

(14)

This equilibrium occurs only if bankruptcy has a sufficiently small impact on firm $j$’s profit, i.e., (12) is violated.

The strategies of firm $j$ and its debtholder described in Lemma 1 are neither continuous nor monotone in beliefs about firm $k$. For example, as long as (12) is violated, $e_j$ increases with beliefs that increase the left hand side of (12), but drops to zero when the left hand side becomes large enough to satisfy (12). Therefore, there are instances in which there is no equilibrium solution to our model and also where there are multiple equilibria. The simulations we describe below suggest that the set of parameters for which either occurs is small. In general, an equilibrium exists and is unique. We focus our remaining analysis on the latter set of parameters.

In Figure 1, we illustrate the effect of bankruptcy costs and firm one’s information environment on the restructuring outcomes described in Lemma 1. To create this figure and the ones that follow, we assume that firm $j$’s cash flow is described by the following function:

$$\pi_j(b_j, b_k, c_k) = \alpha (1 - I_{b_j} \delta)[1 + (1 - I_{c_k})I_{b_k} \delta \gamma + I_{c_k} \gamma]_l,$$  

(15)

where $\alpha$ is the firm’s cash flow when both firms are competitive and are not weakened by bankruptcy, $I_{b_n}$ is a bankruptcy indicator function that takes the value 1 when $b_n = i$ and 0 when $b_n = o$, $\delta$ determines the size of the firm’s bankruptcy cost, $I_{c_k}$ is a competitiveness indicator function that takes the value 1 when $c_k = n$ and 0 when $c_k = y$, and $\gamma$ drives a firm’s benefit when its competitor is weakened by bankruptcy or cannot compete. The variables $\alpha$, $\delta$, and $\gamma$ capture characteristics of the firms’ market and operating environment. Consistent with our assumptions, a firm’s cash flow falls when it enters bankruptcy, and a firm’s bankruptcy cost rises as its competitor become weaker. In all our examples, if firm $j$ enters bankruptcy in an out-of-
bankruptcy equilibrium, we assume that the off-equilibrium-path posterior belief of all agents is that firm \( j \) is weak.\(^{11}\)

In Figure 1, we vary the bankruptcy cost and and debt mispricing by varying \( \delta \) and \( \ell_1 \), respectively. To vary \( \ell_1 \), we increase \( \phi^s_1 \). Consistent with Lemma 1, both firms tend to remain in out-of-bankruptcy equilibria when their bankruptcy costs are high (\( \delta \) is high). A higher value of \( \ell_1 \), raises the mispricing loss firm one’s debtholder suffers if he accepts an offer of \( F^s_1 \) and thus, expands the parameter set that supports bankruptcy equilibria for firm one. In contrast, an increase in \( \ell_1 \) makes firm one a stronger competitor which lowers firm two’s expected bankruptcy cost. Consequently, as Figure 1 illustrates, the set of parameter values that support bankruptcy equilibria for firm two expands. There are two lines delineating the parameter sets that support bankruptcy equilibria for firm two. The upper (lower) line demarcates the parameter set supporting firm two bankruptcy equilibria when firm one restructures outside (inside) bankruptcy. This dependence of firm two’s restructuring outcome on firm one’s characteristics and restructuring outcome is a first glimpse into the spillovers discussed below.

Lemma 1 demonstrates that bankruptcy occurs when a debtholder tries to prevent a firm from exploiting its information advantage to obtain concessions. Since the debtholder randomly rejects offers of \( F^s_j \) and is unable to condition rejection on the firm’s type, the probability of bankruptcy varies with the each firm type’s propensity to offer \( F^s_j \). A strong firm offers \( F^s_j \) with probability one and a weak firm with probability \( e_j < 1 \). Therefore, a strong firm is more likely to be forced into bankruptcy, which makes bankruptcy a noisy signal that the firm is strong.

**Proposition 1.** If a firm is in a bankruptcy equilibrium, it is more likely to restructure in bankruptcy if it is type \( s \).

As is typical with mixed strategy equilibria, in a bankruptcy equilibrium a weak firm’s propensity to seek concessions, \( e_j \), and the debtholder’s propensity to challenge restructuring proposals, \( d_j \), are set to ensure that the agents are willing to randomize because they are indifferent between alternative they face. Therefore, when the debtholder’s loss from pushing the firm into bankruptcy rises, the firm’s propensity to seek concessions, \( e_j \), must rise to leave its debtholder indifferent to accepting or rejecting its offer. Similarly, the firm’s propensity to seek concessions must fall with the debtholder’s mispricing loss from accepting a restructuring offer of \( F^s_j \). This mispricing loss increases with the firm’s debt level and the likelihood ratio

\(^{11}\)Our results are unchanged if we employ an alternate specification for the off-equilibrium-path posterior belief, e.g., if we assume that it is the same as the posterior belief following the firm’s bankruptcy.
ℓ_j. The debtholder’s propensity to force the firm into bankruptcy, d_j is set to leave a weak firm indifferent between making a fair offer and seeking concessions. Therefore, d_j rises with the debt level and ℓ_j as both increase the firm’s gain from debt concessions, and falls with the bankruptcy cost to the firm.

**Proposition 2.** When firm j is in a bankruptcy equilibrium, its propensity to seek concessions from debtholders, e_j, rises with the bankruptcy cost Δ^n_j, and falls with its debt level D_j. The debtholders’ propensity to reject the firm’s restructuring offer, d_j, rises with its debt level D_j, and falls with the bankruptcy cost Δ^n_j.

Proposition 2 only formalizes the effect of one portion of a firm’s bankruptcy cost, Δ^n_j, on its behavior and that of its debtholder. Δ^i_j and Δ^o_j also exert similar influences on firm j’s and its debtholder’s behavior. However, while firm j always faces the prospect that its competitor may not be competitive and thus, Δ^o_j always partially determines its bankruptcy cost, this may not be the case with either Δ^i_j or Δ^n_j. Whether one of these two components feature in firm j’s bankruptcy cost depends on the (expected) restructuring outcome of its competitor; if firm one restructures in bankruptcy, only Δ^i_2 and Δ^n_2 influence firm two’s bankruptcy cost. Similarly, if firm two is in out-of-bankruptcy equilibrium, only Δ^i_1 and Δ^n_1 influence firm one’s bankruptcy cost.

Figures 2 and 3 plot the posterior assessment of firm one’s type conditional on whether its restructuring was completed in or out of bankruptcy, illustrating the information signaled by firm one’s restructuring outcome. For sufficiently high values of δ and low values of ℓ_1, firm one is in an out-of-bankruptcy equilibrium and thus, always completes its restructuring outside bankruptcy. When firm one is in a bankruptcy equilibrium, consistent with Proposition 1, the posterior assessment of it being type s is higher if it restructures inside bankruptcy. Figure 2 illustrates how this posterior assessment declines as firm one’s bankruptcy cost (δ) rises. This change is consistent with Proposition 2 which demonstrates that, as the bankruptcy cost rises, type w becomes more likely to seek concessions and thus, restructure in bankruptcy. For the same reason, the posterior assessment of firm one being type s conditional on restructuring outside bankruptcy rises with δ. In contrast, an increase in the debtholders’ mispricing loss discourages type w from seeking concessions. Therefore, as Figure 3 illustrates, the posterior assessment of firm one being type s conditional on restructuring in (out of) bankruptcy rises (declines) as the likelihood ratio ℓ_1 rises.
4 Spillover and feedback effects from restructuring

It is clear that a firm’s restructuring outcome is determined by expectations regarding its bankruptcy costs. Since a competitor’s restructuring outcome influences the bankruptcy costs, firm one’s restructuring may have spillover effects on firm two’s restructuring. In turn, expectations regarding the spillover effects on firm two’s restructuring may exert a feedback affect on firm one’s restructuring. We now provide insight into these interactions. Since the spillovers and feedback tend to occur only when restructuring in bankruptcy is likely, for the most part, we now focus on situations where both firms are in bankruptcy equilibria. However, when appropriate, we also examine cases where one of the firms may be in an out-of-bankruptcy equilibrium.

4.1 Spillover effect on firm two’s bankruptcy probability

From firm two’s perspective, firm one’s restructuring has two effects; since bankruptcy erodes firm one’s competitiveness, it has a \textit{competitiveness} effect; since firm one’s bankruptcy signals that it is more likely to be strong, it also has an \textit{information} effect. The spillover from firm one’s restructuring to firm two’s negotiation depends on the relative strength of these two effects.

If the competitiveness effect is strong relative to the information effect, firm two’s claimants will believe that firm one is more competitive if it restructures outside bankruptcy. Therefore, they will expect firm two’s bankruptcy to be more costly if firm one restructures in bankruptcy. Faced with a larger bankruptcy cost, firm two’s debtholder will be less willing to challenge firm two’s restructuring offer. In a bankruptcy equilibrium, this accommodating stance induces firm two to seek concession more aggressively if it is weak. Therefore, as we demonstrate in the following proposition, when firm one restructures in bankruptcy, firm two will be less likely to restructure in bankruptcy if it is type \( s \) but more likely to do so if it is type \( w \). This pattern reverses when the competitiveness effect is weak relative to the information effect since firm one’s bankruptcy will result in a stronger competitor for firm two; if firm two is type \( s \) (\( w \)), it is more (less) likely to enter bankruptcy if firm one restructures in bankruptcy.

\textbf{Proposition 3.} \textit{Suppose that firm two remains in the bankruptcy equilibrium whether or not firm one files for bankruptcy.}

\begin{enumerate}
  \item If firm one’s bankruptcy deeply erodes its competitiveness while only weakly signaling it is strong,
i.e.,

\[ \ell_1 < \frac{\Delta^I - \Delta^O}{\Delta^g - \Delta^O}, \]  

(16)

firm two’s probability of restructuring in bankruptcy is lower (higher) if it is type s (w) and firm one restructures in bankruptcy.

2. If (16) is violated, firm two’s probability of restructuring in bankruptcy may be higher (lower) if it is type w (s) and firm one restructures in bankruptcy.

From Proposition 3, it is clear that the information effect of firm two’s restructuring varies with the outcome of firm one’s restructuring. If the competitiveness effect is strong relative to the information effect, conditional on firm one being in bankruptcy, firm two’s bankruptcy will weakly signal that it is strong. In contrast, when the relative strengths of the competitiveness and information effects reverse, conditional on firm one being in bankruptcy, firm two’s bankruptcy will strongly signal that it is strong.

In addition to influencing the manner in which investors should interpret firm two’s restructuring outcome, firm one’s bankruptcy also influences firm two’s unconditional probability of bankruptcy. Let this probability be represented by \( \beta_2(I_2) \). In an out-of-bankruptcy equilibrium, \( \beta_2(I_2) = 0 \). In a bankruptcy equilibrium, this probability equals \( q_2 d_2(I_2) + (1 - q_2) e_2(I_2) d_2(I_2) \), i.e.,

\[ \beta_2(I_2) = q_2 \frac{\phi^s \Delta_2(I_2) + \ell_2 D_2}{\phi^w \Delta_2(I_2) + \ell_2 D_2}, \]  

(17)

By changing firm two’s expected bankruptcy cost, firm one’s restructuring outcome can either raise or lower firm two’s unconditional bankruptcy probability.

As we demonstrate in the following proposition, whether firm two’s unconditional bankruptcy probability rises or falls depends on whether firm one’s bankruptcy raises or lowers firm two’s bankruptcy cost, and whether this change moves firm two from one type of equilibrium to another. For example, consider the case where firm one’s bankruptcy raises firm two’s bankruptcy cost. The increase in the bankruptcy cost may ensure that it becomes too costly for firm two’s debtholder to challenge an offer of \( F_2^s \). The change in the debtholder’s behavior can move firm two from a bankruptcy equilibrium to an out-of-bankruptcy equilibrium. If so, firm two’s unconditional bankruptcy probability will drop to zero. In stark contrast, if the rise in firm two’s bankruptcy cost does not push the firm to an out-of-bankruptcy equilibrium, its unconditional
bankruptcy probability will rise. The bankruptcy probability rises because the increased cost of bankruptcy induces the debtholder to lower the probability of rejecting an offer of \( F_2 \). This encourages firm two to seek concessions more aggressively. The decrease in the probability of debtholder rejection is proportional to the bankruptcy cost of type \( w \) while the increase in the firm’s propensity to seek concessions is proportional to the bankruptcy costs of type \( s \). Therefore, the second effect dominates, resulting in a higher unconditional bankruptcy probability. The effects of firm one’s bankruptcy reverse when firm one’s bankruptcy lowers firm two’s bankruptcy cost. Figure 1 illustrates the link between firm one’s restructuring outcome and firm two’s unconditional probability of bankruptcy. The following proposition formalizes this result.

**Proposition 4.** 1. If (16) holds, firm one’s bankruptcy will raise firm two’s unconditional probability of bankruptcy if firm two remains in a bankruptcy equilibrium and lower it if firm two does not remain in a bankruptcy equilibrium.

2. If (16) is violated, firm one’s bankruptcy may lower firm two’s unconditional probability of bankruptcy if firm two remains in a bankruptcy equilibrium and will raise it if firm two does not remain in a bankruptcy equilibrium.

Underlying Proposition 4 is the fact that a firm’s unconditional bankruptcy probability is a nonmonotone and discontinuous function of its bankruptcy cost. When the bankruptcy cost is low, the firm is in a bankruptcy equilibrium. Therefore, increases in the bankruptcy cost raise its unconditional bankruptcy probability. Once the bankruptcy cost is sufficiently large, an increase can move the firm to an out-of-bankruptcy equilibrium. At this point, its unconditional bankruptcy probability drops to zero and remains there as the bankruptcy cost continues to increase.

### 4.2 Feedback effect on firm one’s bankruptcy probability

Firm one’s claimants recognize that their negotiation exerts a spillover effect on firm two’s restructuring and thus, firm two’s competitiveness. Since firm two’s expected competitiveness influences firm one’s bankruptcy cost, firm one’s claimants will consider the spillover effect when negotiating. A feedback effect on firm one’s restructuring will result if consideration of the spillover effect influences its outcome. For a feedback effect to exist, the joint probability of firm two becoming bankrupt and remaining competitive must vary with firm one’s restructuring outcome. This is not possible when firm two’s restructuring out-
come is not affected by firm one’s restructuring, as is the case if firm two remains in an out-of-bankruptcy equilibrium regardless of the outcome of firm one’s restructuring.

Now consider the case where firm two remains in a bankruptcy equilibrium regardless of the outcome of firm one’s restructuring. If (16) is satisfied, the competitiveness effect of firm one’s bankruptcy is strong relative to its information effect. Therefore, from Proposition 3, it follows that firm one’s bankruptcy will lower (raise) the probability that firm two restructures in (outside) bankruptcy if it is weak (strong). Consequently, firm one’s bankruptcy tends to weaken firm two if it is weak and strengthen it if it is strong. As the following proposition demonstrates, these opposing effects ensure that the joint probability that firm two restructures in bankruptcy and remains competitive is unaffected by the outcome of firm one’s restructuring.

It follows that there is no spillover effect from firm one’s restructuring. For similar reasons, there is no spillover effect even when (16) is violated. Thus, there is no feedback effect from firm one’s restructuring so long as firm two remains in a bankruptcy equilibrium regardless of the outcome of firm one’s restructuring. It is clear, however, that firm one’s restructuring will generate a feedback effect when firm two moves from a bankruptcy equilibrium to an out-of-bankruptcy equilibrium based on the outcome of firm one’s restructuring.

**Proposition 5.** There is a feedback effect from firm one’s restructuring negotiation. However, if firm two remains in a bankruptcy equilibrium or an out-of-bankruptcy equilibrium regardless of firm one’s restructuring outcome, there is no feedback effect from firm one’s restructuring.

From Proposition 5, it follows that a feedback effect from firm one’s restructuring will only exist for parameters where firm two’s bankruptcy cost is close to the level that makes it prohibitively expensive for its debtholder to challenge the firm’s offer. When firm two’s bankruptcy cost is not close to this threshold, it will remain either in an out-of-bankruptcy equilibrium or in a bankruptcy equilibrium regardless of firm one’s restructuring outcome. It follows that only a small set of parameters supports a feedback effect from firm one’s restructuring. Figure 1 provides insight into the size of the parameter set that supports a feedback effect; this is the parameter set that lies between the two curves that separate the sets of parameters supporting bankruptcy and out-of-bankruptcy equilibria for firm two.

Even though there may be no feedback effect, firm two’s characteristics can still influence firm one’s ex
ante bankruptcy probability. This bankruptcy probability is given by

$$\beta_1 = q_1 \frac{\phi_s^1 \Delta_1 + \ell_1 D_1}{\phi_s^1 \Delta_1 + \ell_1 D_1}, \quad (18)$$

which is virtually identical to the expression for firm two’s ex ante bankruptcy probability, (17). An increase in firm two’s competitiveness, captured by $\phi_s^2$, makes bankruptcy less costly for firm one and its debtholders. Since firm one’s equilibrium bankruptcy probability falls along with its bankruptcy cost when it is in the bankruptcy equilibrium, firm one is less likely to enter bankruptcy when firm two is more competitive. Firm two’s ex ante quality, $q_2$, also influences firm one’s ex ante bankruptcy probability. As is clear from (17), in the bankruptcy equilibrium, firm two’s ex ante bankruptcy probability rises with its ex ante competitiveness. When bankruptcy has a sufficiently strong influence on firm two’s competitiveness, firm one’s expected cost from bankruptcy rises and hence, so does its probability of bankruptcy when it is in the bankruptcy equilibrium.

Proposition 6. Suppose firm two remains in a bankruptcy equilibrium whether or not firm one files for bankruptcy. Then, firm one’s ex ante bankruptcy probability, $\beta_1$, is decreasing in $\phi_s^2$ and $\phi_w^2$. Additionally, it is increasing in $q_2$ if and only if (16) holds.

4.3 Security price effects

The competitiveness and information effects of a restructuring both influence a competitor’s profit expectations and thus, move the competitor’s security prices. If the competitiveness effect is strong relative to its information effect, a firm’s bankruptcy boosts its competitor’s expected profit. Therefore, the firm’s bankruptcy will raise its competitor’s share price. This share price increase occurs even though the competitor’s unconditional probability of bankruptcy may also rise. When the relative strengths of bankruptcy’s competitiveness and information effects reverse, the competitor’s stock price reaction to a firm’s bankruptcy can reverse; the stock price can drop on news of the bankruptcy.

The price of a competitor’s debt responds very differently to a firm’s restructuring. One reason for the difference is that the competitor’s debtholder does not share in changes in its expected profit resulting from the firm’s restructuring. In the case of firm two, there is a second reason; firm two’s debtholder is always adversely affected by any development in firm one’s restructuring that increases the likelihood that firm two will seek debt concessions. For example, consider the case where the competitiveness effect of firm one’s
bankruptcy is stronger than its information effect. While firm two’s expected profit rises with firm one’s bankruptcy so does the cost of its own bankruptcy. This discourages firm two’s debtholder from rejecting an offer of \( F^2 \) and encourages firm two seeks debt concessions with a higher probability. Therefore, firm two’s debtholder is less likely to receive a fair offer from type \( w \). Since the debtholder’s expected payoff from an offer of \( F^j \) does not vary with their response in a bankruptcy equilibrium, the debtholder’s expected payoff drops when firm one enters bankruptcy. Consequently, even as firm two’s share price rises in response to firm one’s bankruptcy, the price of its debt may fall.

**Proposition 7.**

1. If the bankruptcy of firm \( k, k = 1,2 \), has a sufficiently large negative impact on its competitiveness, i.e.,

\[
\ell_k < \frac{\Delta_j^i - \Delta_j^o}{\Delta_j^o - \Delta_j^n},
\]

firm \( j \)'s debt price reacts weakly negatively to firm \( k \)'s bankruptcy.

2. If (19) holds and:

\[
\ell_k < \frac{\pi_j(b_j,i,y) - \pi_j(b_j,o,y)}{\pi_j(b_j,i,n) - \pi_j(b_j,o,y)},
\]

firm \( j \)'s stock price reacts positively to firm \( k \)'s bankruptcy.

3. If (19) is violated, the stock and bond price reactions may reverse.

Figure 4 illustrates how firm two’s share price reacts to firm one’s bankruptcy. Consistent with Proposition 7, because the information effect from firm one’s bankruptcy dominates the competitiveness effect for low values of \( \delta \), firm two’s share price is lower when firm one restructures in bankruptcy than when it restructures outside bankruptcy. For high values of \( \delta \), the competitiveness effect dominates and the ordering between firm two’s conditional share prices is reversed. Figure 4 also demonstrates that, when firm one files for bankruptcy, firm two’s share price rises as \( \delta \) rises and bankruptcy extracts a greater toll on firm one’s competitiveness.

In Figure 5 we plot the price of firm two’s debt against the likelihood ratio \( \ell_1 \), that drives mispricing on firm one’s debt. We increase in \( \ell_1 \) by raising \( \phi^1 \). Consequently, as \( \ell_1 \) rises, firm two is faced with a stronger competitor and thus, a lower bankruptcy cost. The fall in its bankruptcy cost discourages firm
two from seeking concessions from the debtholder, resulting in a higher price for its debt. The figure also illustrates how the price effect of news of firm one’s restructuring outcome varies with the relative strength of the information effect of firm one’s bankruptcy. When $\ell_1$ is small, the competitiveness effect of firm one’s bankruptcy dominates while the information effect dominates when $\ell_1$ is large. Therefore, firm one’s bankruptcy signals weaker (stronger) competition and a larger (smaller) bankruptcy cost for firm two when $\ell_1$ is small (large). Since a larger bankruptcy cost encourages firm two to seek concessions, its bond price declines (rises) on news of firm one’s bankruptcy when $\ell_1$ is small (large).

Stock prices also react to developments during a firm’s own restructuring. For example, a firm’s stock price will react to the news of its bankruptcy or the completion of its restructuring outside bankruptcy. Consider firm one’s stock price response to developments in its own restructuring. In a bankruptcy equilibrium, conditional on being type $s$, firm one’s payoff is given by

$$\phi_s^i E[\pi_1(o, b_2, c_2)] - D_1.$$  \hspace{1cm} (21)

Conditional on being type $w$, firm one is indifferent between making a fair offer, $F_1^w$, and trying to obtain concessions from its debtholder. Therefore, the firm’s expected payoff conditional on being type $w$ is given by

$$\phi_w^i E[\pi_1(o, b_2, c_2)] - D_1.$$  \hspace{1cm} (22)

It follows that firm one’s share price before it begins restructuring is given by

$$S_1 = (\phi_s^i + q_1 (\phi_s^i - \phi_w^i)) E[\pi_1(o, b_2, c_2)] - D_1.$$  \hspace{1cm} (23)

Firm one’s stock price will change depending on whether it restructures inside or outside bankruptcy. The news that firm one has entered bankruptcy signals information regarding its type. It also results in an updated estimate of the expected bankruptcy cost the firm will bear if it is revealed to be type $w$ in bankruptcy. Therefore, firm one’s share value immediately following news of its bankruptcy will be given by

$$S_1(i) = E[\phi_i | b_1 = i] E[\pi_1(o, b_2, c_2)] - D_1 - Pr(w | b_1 = i) \phi_w^i \Delta_1,$$  \hspace{1cm} (24)
where $Pr(w|b_1 = i)$ represents the conditional probability that firm one is type $w$ if it restructures in bankruptcy. Beliefs regarding firm one will also have to be revised if it restructures outside bankruptcy. The share price will reflect the expected gain to type $w$ from debt forgiveness. Therefore, following the news that firm one’s offer has been accepted by its debtholder, its share price will be given by

$$S_1(o) = E[\phi_1'|b_1 = o]E[\pi_1(o,b_2,c_2)] - D_1 + Pr(w|b_1 = o)\ell_1 D_1,$$

where $Pr(w|b_1 = o)$ represents the conditional probability that firm one is type $w$ given that it restructures outside bankruptcy.

In Figure 6, we illustrate the response of firm one’s stock price to news about its restructuring. The figure illustrates how firm one’s share price falls as the perception of firm two’s competitiveness ($q_2$) rises. Firm one’s share price responds positively to news of its bankruptcy when $\ell_1$ is relatively high. When $\ell_1$ is relatively high, so is the uncertainty regarding firm one’s type. Therefore, firm one’s bankruptcy results in positive revision of the assessment that firm one is type $s$ that is large enough to offset the expected deadweight cost of bankruptcy. As Figure 6 illustrates, when $\ell_1$ is relatively small, the information effect from firm one’s bankruptcy is muted and weaker the deadweight cost of bankruptcy. Therefore, firm one’s share price reacts negatively to news of its bankruptcy.

## 5 Robustness and extensions

Our assumptions regarding the nature of bankruptcy and its effect on a firm and its competitor are central to the spillover and feedback effects we have described thus far. We now explore the effect of modifying key assumptions that drive these effects. First, we examine the effect of assuming that, instead of being competitors, the two firms share a business partnership such as a customer-supplier relationship. Therefore, a firm’s cash flow declines rather than increases when the second firm becomes less competitive because of bankruptcy. Next, we explore the effect of introducing a (fixed) bankruptcy cost that does not vary with a firm’s competitiveness. Finally, we examine the possibility that, by insulating it from the demands of its claimants, bankruptcy may increase a firm’s competitiveness rather than eroding it.
5.1 Firms are business partners

It is natural to assume that an event that erodes a firm’s competitiveness will boost its competitors’ profits. Similarly, it is natural to assume that the erosion of a firm’s competitiveness will hurt its customers’ and suppliers’ profits. For example, if a firm’s products become less attractive to customers because it files for bankruptcy, its suppliers will suffer because of reduced demand for their output when the firm enters bankruptcy. Similarly, if a firm’s operations are disrupted because of its bankruptcy, it may not be able to fulfill its agreements with its customers, hurting their profits. We demonstrate that, when the relationship between two firms switches from a competitive one to a partnership, the spillover effects from a restructuring also change dramatically; they reverse.

We capture the complementarities between two partner firms’ performance by replacing our assumptions regarding the effects of bankruptcy ((6) and (8)) with the following two assumptions:

\[ \pi_j(b_j, b_k, n) < \pi_j(b_j, i, y) < \pi_j(b_j, o, y), \]  
\[ \Delta_n^j < \Delta_i^j < \Delta_o^j. \]  

(26)  

(27)

The first assumption above, (26), ensures that a firm is most profitable when its partner is competitive and has not experienced bankruptcy, and least profitable when its partner is unable to compete. We extend our assumption that the size of a firm’s bankruptcy cost is proportional to its profitability to the changed competitive landscape via (27), i.e., bankruptcy is most costly when a firm’s partner is competitive and has not experienced bankruptcy, and least costly when its partner is unable to compete.

These changes in our assumptions do not affect the conditions for out-of-bankruptcy equilibria or bankruptcy equilibria. Moreover, a firm’s bankruptcy continues to exert both a competitiveness effect and information effect. However, because of the change in the two firms’ relationship to each other, the impact of each of these two effects on the second firm is reversed. By eroding a firm’s competitiveness, its bankruptcy lowers its partner’s cash flow. Therefore, the competitiveness effect hurts the partner. A strong firm continues to be more likely to restructure in bankruptcy, ensuring that bankruptcy continues to act as a noisy signal that the firm is strong, which is good news for the partner. Therefore, the direction of the information effect is also reversed. Since the directions of the two effects of bankruptcy are reversed so are the spillover effects we have described earlier.
Proposition 8. Suppose that firm two remains in the bankruptcy equilibrium whether or not firm one files for bankruptcy. Then, if (16) is satisfied and bankruptcy’s information effect is weak relative to its competitiveness effect:

1. Firm two’s probability of restructuring in bankruptcy is higher (lower) if it is type s (w) and firm one restructures in bankruptcy.

2. The unconditional probability that firm two will restructure in bankruptcy is higher when firm one restructures in bankruptcy.

3. The price of firm two’s debt will rise on news of firm one’s bankruptcy.

4. If additionally (20) holds for j = 2, firm two’s stock price will react negatively to firm one’s bankruptcy.

When (16) is reversed, these spillover effects may reverse.

Despite the change in the two firms’ relationship, if firm two remains in a bankruptcy equilibrium or remains in an out-of-bankruptcy equilibrium regardless of firm one’s restructuring outcome, the joint probability that firm two is competitive and in bankruptcy does not vary with firm one’s restructuring outcome. Therefore, as has been the case thus far, a feedback effect from firm one’s restructuring is relatively rare. It only exists when firm two’s debtholder is close to being indifferent between accepting a pooling offer of $F_2^s$ and rejecting it, causing firm two to switch between an out-of-bankruptcy and bankruptcy equilibrium as firm one’s restructuring outcome changes.

5.2 Direct bankruptcy costs

Thus far, we have assumed that the only cost associated with a firm’s bankruptcy is the erosion of its competitiveness, and the resulting bankruptcy cost is proportionally higher when the firm’s competition is weaker. We now loosen this assumption by considering bankruptcy costs that do not vary with a firm’s competitive position. Direct bankruptcy costs such as lawyers’ fees and court fees are examples of such fixed costs. We demonstrate that these direct bankruptcy costs influence a firm’s restructuring very differently than do the type of bankruptcy cost we have considered thus far. Moreover, a pervasive feedback from firm one’s restructuring emerges once these direct costs are introduced. However, this feedback effect is quite weak.

To examine the effect of a direct bankruptcy cost, we decompose a firm’s bankruptcy cost into the following two parts: an indirect cost resulting from the erosion of the firm’s competitiveness that is proportional
to its competitive position, and a direct cost of \( L_j \) that is not a function of the firm’s competitive position. We continue to assume that the bankruptcy court imposes a fair restructuring, forcing the firm (debtholder) to bear the entire bankruptcy cost (including \( L_j \)) if the original offer is judged to be unfair (fair). We also continue to assume that the firm is more valuable than the sum of its outstanding debt and all bankruptcy costs.

The decomposition of the bankruptcy costs results in some cosmetic changes to the several equilibrium conditions. The necessary and sufficient condition for an out-of-bankruptcy equilibrium (12) changes to:

\[
q_j(L_j + \phi^s_j \Delta_j(\mathcal{I}_j)) > (1 - q_j)\ell_j D_j. \tag{28}
\]

In bankruptcy equilibria, the expressions for the probability with which a weak firm makes an offer of \( F^w_j \) and the probability with which the debtholder rejects such an offer, (13) and (14), change to:

\[
e_j(\mathcal{I}_j) = \frac{q_j(L_j + \phi^s_j \Delta_j(\mathcal{I}_j))}{(1 - q_j)\ell_j D_j}, \tag{29}
\]

and

\[
d_j(\mathcal{I}_j) = \frac{\ell_j D_j}{\phi^w_j \Delta_j(\mathcal{I}_j) + \ell_j D_j + L_j}, \tag{30}
\]

respectively. The expression for a firm’s unconditional bankruptcy probability ((17) and (18)) changes to:

\[
\beta_j(\mathcal{I}_j) = q_j \frac{\phi^s_j \Delta_j(\mathcal{I}_j) + \ell_j D_j + L_j}{\phi^w_j \Delta_j(\mathcal{I}_j) + \ell_j D_j + L_j}. \tag{31}
\]

The insensitivity of the direct cost to a firm’s type ensures that it influences the restructuring outcomes very differently than a type-sensitive indirect bankruptcy cost. In bankruptcy equilibria, a debtholder is concerned about the bankruptcy cost he will bear if he incorrectly rejects a fair offer from a strong firm. The bankruptcy cost that the debtholder pays is based on the cost for a strong firm. In contrast, the bankruptcy cost for a weak firm is only important for a weak firm that is faced with the possibility that its attempt to seek concessions is rejected by its debtholder. If bankruptcy only generates indirect bankruptcy costs, a strong firm faces a larger bankruptcy cost than a weak firm and its cost rises faster as bankruptcy becomes more injurious to its competitiveness. Therefore, an increase in the indirect cost of bankruptcy raises the
likelihood that a weak firm will seek concessions faster than it lowers the likelihood that its debtholder will reject an offer of $F^j$. As a consequence, the unconditional probability of a firm’s bankruptcy rises along with the indirect bankruptcy cost. In contrast, the direct cost of bankruptcy is insensitive to the firm’s competitiveness. Therefore, an increase in the direct cost of bankruptcy lowers the gap between the bankruptcy costs of a strong and weak firm. As a consequence, the likelihood that a weak firm will seek concessions rises slower than the fall in the likelihood that its debtholder will reject an offer of $F^j$. Therefore, in contrast to the effect of an increase in the indirect cost of bankruptcy, an increase in the direct cost of bankruptcy lowers the unconditional probability of a firm’s bankruptcy.

**Proposition 9.** Suppose firm two is in the bankruptcy equilibrium. For a given set of beliefs about the type of firm one, firm two’s ex-ante probability of restructuring in bankruptcy decreases with the direct cost of its bankruptcy.

When bankruptcy only gives rise to indirect costs, a feedback effect to firm one’s restructuring exists only for a limited parameter set (Proposition 5), as the competitiveness effect of bankruptcy is typically exactly offset by the change in the likelihood that a strong firm restructures outside bankruptcy and avoids the erosion of its competitiveness associated with bankruptcy. The introduction of a direct bankruptcy cost upsets this delicate balance, and there is now a pervasive feedback effect. By lowering the type-sensitivity of a firm’s bankruptcy cost, a direct bankruptcy cost ensures that bankruptcy’s competitive effect is not completely offset by the change in the likelihood of a strong firm restructuring outside bankruptcy.

**Proposition 10.** When there is a direct cost of bankruptcy, in a bankruptcy equilibrium, firm two’s strategy and competitiveness are dependent on the outcome of firm one’s restructuring. Specifically, the joint probability that firm two restructures in bankruptcy and remains competitive,

$$q_2 \phi_2^w \Delta_2(\mathcal{S}_2) + \ell_2 D_2 + L_2 (1 - \ell_2) \over \phi_2^w \Delta_2(\mathcal{S}_2) + \ell_2 D_2 + L_2,$$

(32)

varies with the outcome of firm one’s restructuring.

It is clear that (32) varies with firm two’s expected indirect bankruptcy cost, $\Delta_2(\mathcal{S}_2)$, which, in turn, varies with firm one’s restructuring outcome. Since firm one’s claimants will consider these expectations when negotiating, in the presence of the feedback effect from firm one’s restructuring we now have to deal
with iterated expectations. This greatly complicates the analysis. Therefore, we rely on a numerical example to illustrate the feedback effect.

The feedback effect, if any, manifests itself in firm one’s expected bankruptcy cost, \( \Delta_1 \). Thus, in Figure 7 we plot how this expected cost varies with the direct bankruptcy cost. With no direct cost (dashed line), there is no feedback effect. So, the expected indirect cost tends to increase linearly with firm one’s own cash flow loss \( \delta \) from bankruptcy. The only exception is the small region where firm two changes from bankruptcy to out-of-bankruptcy equilibrium depending on firm one’s outcome. When bankruptcy also has a direct cost, firm one’s bankruptcy affects firm’s two restructuring outcome and competitiveness. For the parameters shown in the figure, the competitive effect dominates, and firm one’s bankruptcy increases firm two’s bankruptcy. This results in a larger joint probability that firm two restructures in bankruptcy and remains competitive, which in turn reduces the expected indirect cost of bankruptcy for firm one. This feedback effect on firm one’s indirect cost of bankruptcy is responsible for the solid line representing firm one’s expected bankruptcy costs when bankruptcy gives rise to direct costs lying below the dashed line. The proximity of two lines, however, underlines how small this feedback effect is.

5.3 Bankruptcy enhances competitiveness

Bankruptcy is intended to allow viable firms to restructure operations. The automatic stay on creditors imposed by bankruptcy limits the disruption to a restructuring firm’s operations. There are several examples of firms that have been able to use this protection afforded by bankruptcy to restructure their operations and become stronger competitors. In light of this evidence, we now consider the effect of assuming that firms might use bankruptcy protection to increase their competitiveness. If this increase in competitiveness is sufficient to ensure that bankruptcy increases a firm’s expected cash flow, the firm will always conspire with its debtholders to enter bankruptcy. To rule out this sort of extreme behavior, we continue to maintain the assumption introduced in the previous subsection that bankruptcy imposes a direct cost on a firm. Moreover, the direct cost is large enough to ensure that, despite the firm’s improved competitiveness, bankruptcy is costly.

Specifically, we assume that:

\[
\pi_j(b_j, b_k, n) > \pi_j(b_j, o, y) > \pi_j(b_j, i, y), \tag{33}
\]
\[ \Delta_j^o < \Delta_j^0 < \Delta_j^i < 0, \] 
(34)

and

\[ L_j + \Delta_j^0 > 0. \] 
(35)

Assumption (33) formalizes the notion that bankruptcy makes a firm more competitive. Assumption (34) ensures that, because its competitor becomes stronger in bankruptcy, a firm’s gain from entering bankruptcy is smallest when its competitor is also in bankruptcy. Assumption (35) ensures that bankruptcy results in a deadweight loss and thus, firms will prefer to avoid it.

With these modifications, bankruptcy both strengthens a firm and acts as a noisy signal that it is strong. A strong firm lowers the benefit its competitor can reap from entering bankruptcy. Consequently, a firm’s bankruptcy raises its competitor’s bankruptcy cost. It follows that the spillover effects from firm one’s restructuring on firm two’s restructuring and price of debt are the same as those described in Propositions 3, 4, and 7 for the case where firm one’s bankruptcy raises firm two’s bankruptcy cost, i.e., condition (19) is satisfied and the competitiveness effect in the base model dominates its information effect. The spillover effect on firm two’s stock price, however, is the reverse of the one described in Proposition 7 for the case where condition (19) is satisfied. This reversal occurs because both the information and competitiveness effects of firm one’s bankruptcy indicate that firm two’s profit will be lower if firm one restructures in bankruptcy.

**Proposition 11.** Suppose that firm two remains in the bankruptcy equilibrium whether or not firm one files for bankruptcy. Then:

1. Firm two’s probability of restructuring in bankruptcy is lower (higher) if it is type s (w) and firm one restructures in bankruptcy.
2. The unconditional probability that firm two will restructure in bankruptcy is higher when firm one restructures in bankruptcy.
3. Both the price of firm two’s debt and the price of firm two’s stock will react negatively to firm one’s bankruptcy.
6 Empirical Implications

Our model focuses on four determinants of spillover and feedback effects of distressed firm restructurings: the nature of the distressed firm’s relationship with other firms (competitors or partners), the relative importance of indirect bankruptcy costs, the degree of informational asymmetry between debtholders and firms, and the nature of bankruptcy.

Several studies have investigated the impact of a firm’s restructuring on related firms. Lang and Stulz (1992), Cheng and McDonald (1996), and Ferris, Jayaraman and Makhija (1997) have focused on the effect of a firm’s bankruptcy on the security prices of its competitors. Herzl, Officer, and Rogers (2008), and Fernando, May, and Megginson (2011) have documented the security price responses of supplier and customer firms to news of a firm’s bankruptcy. Consistent with our results, these studies find that a firm’s bankruptcy has a significant impact on the prices of related firms. Moreover, the nature of the firms’ relationship influences the impact.

There is no systematic empirical analysis of the three remaining determinants of spillover and feedback effects of distressed firm restructurings that we identify. To guide research on this subject, we now provide several novel testable predictions supported by our analysis.

1. If a firm belongs to an industry where bankruptcy significantly disrupts operations, its bankruptcy filing will raise its competitors’ stock prices, depress the prices of their debt claims, and increase the probability that they will restructure in bankruptcy.

2. If a firm belongs to an industry where bankruptcy significantly disrupts operations, its bankruptcy filing will lower its suppliers’/customers’ stock prices, raise the prices of their debt claims, and lower the probability that they will restructure in bankruptcy.

3. If the level of information asymmetry surrounding a firm is high, its bankruptcy will lower its competitors’ stock prices, raise the prices of their debt claims, and lower the probability that they will restructure in bankruptcy.

4. If the level of information asymmetry surrounding a firm is high, its bankruptcy will raise its suppliers’/customers’ stock prices, lower the prices of their debt claims, and raise the probability that they will restructure in bankruptcy.
5. If a firm belongs to a legacy industry with high pension obligations or a heavily unionized workforce, its bankruptcy filing will lower its competitors’ stock prices and the prices of their debt claims, and raise the probability that they will restructure in bankruptcy.

Predictions 1 and 2 highlight the role of the competitiveness effect of bankruptcy. As many finance textbooks and the authors of several research papers in this area have acknowledged, the toll bankruptcy imposes on a firm’s competitiveness will vary across industries (see, e.g., Lang and Stulz (1992), Cheng and McDonald (1996), and Ross, Westerfield, and Jaffe (2010)). These costs are likely to vary systematically with the importance of long-term relationships between the customers and the firms, the importance of a synchronized and efficient supply chain, and the depth of the job market for employees. Industry concentration is also likely to be an important determinant of the competitiveness effect of bankruptcy since a firm’s bankruptcy is likely to have a larger impact on its competitors’ profitability if it has fewer competitors. Other estimates of the size of the competitiveness effect include prices and products offered by bankruptcy firms and their competitors (Ciliberto and Schenone, 2010), and the effect of bankruptcy on profitability measures such as return on equity (Iqbal (2002)).

The impact of variation in information asymmetry on the spillover and feedback effects of distressed firm restructurings is highlighted by Predictions 3 and 4. Existing studies on this subject have acknowledged that information asymmetry influences these effects. However, directly contradicting our results, they have tended to conjecture that a firm’s bankruptcy signals adverse information (see, e.g., Lang and Stulz (1992)). Moreover, these studies have not attempted to control for self-selection by firms that file for bankruptcy, the root of the information and thus, the feedback and spillover effects we derive. The degree of information asymmetry between a firm’s claimants is likely to vary systematically across firms and industries. It should be high in industries that are relatively opaque and employ complex productions technologies. The level of information asymmetry surrounding a firm should also vary systematically with its level of disclosure, the number of analysts covering the firm, the difference between the number of equity and debt analysts covering the firm, the firm’s mix of bank and public debt, and the concentration of the firm’s ownership with insiders.

Bankruptcy may benefit some firms (Wruck (1990), and Phillips and Sertsios (2011)). For example, firms from several industries including the airline and automobile industries appear to have been able to use the protection afforded by bankruptcy to restructure their operations and improve their competitiveness.
It is likely that a firm’s ability to boost its profitability through bankruptcy varies systematically across industries. Prediction 5 is based on this possibility. The prediction identifies two sources of the benefit from a bankruptcy filing, the ability to shed pension obligations and lower the wage bill. However, there are likely other impediments to competitiveness that can be removed via a bankruptcy filing, e.g., a court judgement (Cutler and Summers (1988)).

To keep our model manageable, we have treated overall demand and technology as fixed exogenous variables. Shifts in industrywide technology and demand can lead to widespread financial distress. They can also give rise to feedback and spillover effects since investors can use the information about technology and demand they obtain from one firm’s restructuring to fix their strategies in a related firm’s restructuring (Herzel, Officer, and Rogers, 2008). Therefore, when testing our predictions, it is important to control for systematic shocks that can affect the industry’s cash flows.

7 Conclusion

Developments during a debt renegotiation by a financially distressed firm often have a profound impact on the firm’s competitors, suppliers, and customers. This paper investigates the determinants of this impact using a game-theoretic model of debt restructuring, where asymmetric information between a firm and its debtholders can cause a breakdown in negotiations and force the firm to restructure in bankruptcy. Our model suggests that there are two important determinants of the spillover effect on the firm’s competitors, suppliers, and customers: the information generated about the firm’s competitiveness and the size of indirect bankruptcy costs incurred due to disrupted operations, lost customers, or weakened worker relations. The overall spillover effect depends on the relative importance of these two factors. It is also crucially dependent on whether bankruptcy impedes firm competitiveness and profitability or, as commentators have argued, helps a firm regain its competitiveness and improve its profitability. We also show that expectation of the spillover effects may feed back on to the firm’s own restructuring negotiations. However, typically, the feedback effect is weak.
References


Appendix

Proof of Lemma 1: The restructuring analysis for a single firm is virtually identical to that of Giammarino (1988). Therefore, we provide a sketch of the proof.

In equilibrium, inequality (12) is either satisfied or violated. We first establish that, if (12) is satisfied, the equilibrium is an out-of-bankruptcy equilibrium, and the claimants follow the strategies described in the Lemma 1. To see this note that it is a dominant strategy for the debtholder to reject an offer lower than $F^s_j$ and a dominant strategy for type $s$ to offer $F^s_j$. It is also optimal for type $w$ to offer $F^s_j$ with certainty since any other offer will either be higher or be rejected by the debtholder. Inequality (12) ensures that accepting an offer of $F^s_j$ is incentive-compatible for the debtholder given the optimal strategies of types $s$ and $w$. The uniqueness of this equilibrium follows directly from noting that, when (12) is satisfied, the debtholder will accept an offer of $F^s_j$ even when they believe that type $w$ will offer $F^w_j$ with certainty. Since this offer maximizes type $w$’s payoff, it will always offer $F^s_j$.

We next establish that, if (12) is violated, the equilibrium is a bankruptcy equilibrium, as defined in the Lemma. In this case, it is still a dominant strategy for the debtholder to reject any offer lower than $F^s_j$ and a dominant strategy for type $s$ to offer $F^s_j$. However, it cannot be an equilibrium strategy for type $w$ to offer $F^s_j$ with certainty since inequality (12) is violated implying that the debtholder rejects $F^s_j$ with certainty leaving type $w$ better off if it deviates and offer $F^w_j$. Thus, in equilibrium, type $w$ makes an offer different from $F^s_j$ with a nonzero probability. Because any offer different from $F^s_j$ signals to the debtholder that it is coming from type $w$, the debtholder rejects the offer as long as it is below $F^w_j$, and accepts it as long as it is at or above $F^w_j$. Thus, in equilibrium, type $w$ offers $F^w_j$ with a positive probability. To see that this probability is less than one, note that, If type $w$ were to offer $F^w_j$ with certainty, an offer of $F^s_j$ would signal type $s$ to the debtholder. It follows that the debtholder would always accept an offer of $F^s_j$. However, if type $w$ expects $F^s_j$ to be accepted with certainty, type will deviate to offering $F^s_j$ with certainty. Therefore, in equilibrium, type $w$ offers $F^w_j$ with probability $0 < e_j < 1$, and the debtholder accepts $F^w_j$ with certainty, and rejects $F^s_j$ with probability $0 < d_j < 1$.

The debtholder is willing to randomize between accepting and rejecting an offer of $F^s_j$ if the debtholder is indifferent between these two alternatives. Rejecting $F^s_j$ is costly to the debtholder if the bankruptcy court finds the firm to be type $s$ and thus requires the debtholder to cover the expected bankruptcy cost of $\phi^s_j \Delta_j(s_j)$. Accepting $F^s_j$ is costly to the debtholder if the firm happens to be type $w$ and thus underpays the
debtholder \(\phi_j^w(F_j^w - F_j^s)\) in expectation. Given that type \(s\) offers \(F_j^s\) with certainty and type \(w\) makes such an offer with probability \(e_j\), the debtholder’s posterior probability that the firm is type \(s\) following an offer of \(F_j^s\) is
\[
\frac{q_j}{q_j + (1 - q_j)e_j}.
\]
Hence, the debtholder is indifferent between accepting and rejecting an offer of \(F_j^s\) if \(e_j\) satisfies:
\[
\frac{q_j}{q_j + (1 - q_j)e_j} \phi_j^s(F_j^s - F_j^s) = \frac{(1 - q_j)e_j}{q_j + (1 - q_j)e_j} \phi_j^w(F_j^w - F_j^s).
\]
Rearranging this expression gives us (13).

Similarly, type \(w\) is willing to randomize between offering \(F_j^s\) and \(F_j^w\) if type \(w\) is indifferent between the two alternatives. Consider first the case of \(j = 2\). If type \(w\) firm two offers \(F_2^w\), it ends up paying \(D_2\) in expectation. If it offers \(F_2^s\), it stands to earn a mispricing gain of \(\phi_2^w(F_2^w - F_2^s)\) if the debtholder accepts the offer, which happens with probability \(1 - d_2\). If the debtholder rejects the offer, which happens with probability \(d_2\), firm two stands to incur a bankruptcy cost of \(\phi_2^w \Delta_2\) in addition to paying the debtholder \(D_2\) in expectation. Therefore, type \(w\) is indifferent between offering \(F_2^s\) and \(F_2^w\) if \(d_2\) satisfies:
\[
D_2 = (1 - d_2)(D_2 - \phi_2^w(F_2^w - F_2^s)) + d_2(D_2 + \phi_2^w \Delta_2(\mathcal{I}_2)).
\]
Rearranging this expression gives us (14) for \(j = 2\).

Now consider firm one. The indifference condition for type \(w\) firm one may differ from that for type \(w\) firm two because firm one must take into account not only the response of its debtholder, but also the reaction of firm two to firm one’s restructuring outcome. Specifically, if firm one’s bankruptcy affects firm two’s restructuring negotiations, the resulting changes in firm two’s restructuring outcome will in turn affect firm one’s expected competitive position in period three. Taking this into account, type \(w\)’s indifference condition can be derived as follows. If the firm offers \(F_1^w\), it will pay the debtholder \(D_1\) in expectation and will earn an expected profit of \(E[\pi_1(o, b_2, p_2) | b_1 = 0]\) with probability \(\phi_1^w\). If the firm offers \(F_1^s\) and the debtholder accepts the offer, the firm pays to the debtholder \(D_1 - \phi_1^w(F_1^w - F_1^s)\) in expectation. Finally, if the firm offers \(F_1^s\) and the debtholder rejects the offer, the firm pays to the debtholder \(D_1\) in expectation and earns an expected profit of \(E[\pi_1(i, b_2, p_2) | b_1 = i]\) with probability \(\phi_1^w\). Since the debtholder rejects \(F_1^s\) with
probability \(d_1\), type \(w\) is indifferent between offering \(F^s_1\) and \(F^w_1\) if \(d_1\) satisfies:

\[
\phi^w_1 E[\pi_1(o, b_2, p_2)|b_1 = o] - D_1 = (1 - d_1) (\phi^w_1 E[\pi_1(o, b_2, p_2)|b_1 = o] - D_1 + \phi^w_1 (F^w_1 - F^s_1)) + d_1 (\phi^w_1 E[\pi_1(i, b_2, p_2)|b_1 = i] - D_1).
\]

The above can be rewritten as

\[
D_1 = (1 - d_1) (D_1 - \phi^w_1 (F^w_1 - F^s_1)) + d_1 (D_1 + \phi^w_1 \Delta_1).
\]

(36)

Rearranging this expression gives us (14) for \(j = 1\). \(\square\)

**Proof of Proposition 1:** Suppose firm \(j\) is in the bankruptcy equilibrium. Then, type \(s\) firm \(j\) offers \(F^s_j\) with certainty and the debtholder rejects it with probability \(d_j\). Thus, type \(s\) restructures in bankruptcy with probability \(d_j\). Type \(w\), however, offers \(F^s_j\) with probability \(e_j < 1\) and thus, restructures in bankruptcy with probability \(e_j d_j < d_j\). \(\square\)

**Proof of Proposition 2:** From Lemma 1, the expressions for \(e_j\) and \(d_j\) are given by

\[
e_j(\mathcal{S}_j) = \frac{q_j \phi^j_1 \Delta_j(\mathcal{S}_j)}{(1 - q_j) \ell_j D_j}, \text{ and}
\]

\[
d_j(\mathcal{S}_j) = \frac{\ell_j D_j}{\phi^w_1 \Delta_j(\mathcal{S}_j) + \ell_j D_j}.
\]

respectively. These expressions imply that \(e_j\) decreases while \(d_j\) increases with \(D_j\). Additionally, \(e_j\) increases while \(d_j\) decreases with \(\Delta_j(\mathcal{S}_j)\). The proposition then follows from observing that \(\Delta_j(\mathcal{S}_j)\) increases with \(\Delta^w_j\) for any \(j\) and \(\mathcal{S}_j\). \(\square\)

**Lemma 2.** When (16) holds, then \(\Delta_2(b_1)\) satisfies

\[
\Delta_2(i) > \Delta_2(o).
\]
Proof of Lemma 2: When (16) holds, we have

\[
\Delta_2(i) = \Delta_2^s - E[\phi_1 | b_1 = i](\Delta_2^s - \Delta_2^o) > \Delta_2^s - \phi_1^s(\Delta_2^s - \Delta_2^o)
\]
\[
> \Delta_2^o - \phi_1^w(\Delta_2^o - \Delta_2^s)
\]
\[
> \Delta_2^o - E[\phi_1 | b_1 = o](\Delta_2^o - \Delta_2^o) = \Delta_2(o),
\]

In the above, the first inequality follows from observing that \(\Delta_2^s > \Delta_2^o\) according to (16), and that \(E[\phi_1 | b_1 = i] < \phi_1^s\). The second inequality follows from (16). Finally, the last inequality follows from observing that \(\Delta_2^o > \Delta_2^o\) according to (16), and that \(\phi_1^w < E[\phi_1 | b_1 = i]\). □

Lemma 3. When (16) holds, there does not exist an equilibrium where firm two is in the bankruptcy subgame equilibrium when \(b_1 = i\) and in the out-of-bankruptcy subgame equilibrium when \(b_1 = o\).

Proof of Lemma 3: From Lemma 1, firm two is in the out-of-bankruptcy bankruptcy equilibrium if and only if (12) holds. Because, from Lemma 2, (16) implies \(\Delta_2(i) > \Delta_2(o)\), it is not possible for (12) to hold when \(b_1 = o\) and not hold when \(b_1 = i\). □

Proof of Proposition 3: 1. First note that, for firm two, \(\mathcal{S}_2 = b_1\). As argued in the proof of Proposition 1, the probability of bankruptcy for a type \(s\) firm two, \(\beta_2^s(\mathcal{S}_2) = \beta_2^s(b_1)\), can be expressed as

\[
\beta_2^s(b_1) = d_2(b_1) = \frac{e_2(b_1)d_2(b_1)}{\frac{e_2}{\phi_2^s \Delta_2(b_1)} + e_2D_2}, \quad (37)
\]

where the second equality follows from (14), and the probability of bankruptcy for a type \(w\) firm two, \(\beta_2^w(\mathcal{S}_2) = \beta_2^w(b_1)\), can be expressed as

\[
\beta_2^w(b_1) = e_2(b_1)d_2(b_1) = \frac{q_2 \phi_2^w \Delta_2(b_1)}{(1 - q_2)(\phi_2^w \Delta_2(b_1) + e_2D_2)}, \quad (38)
\]

where the second equality follows from (13) and (14). These expressions depends on firm one’s bankruptcy status \(b_1\) only through \(\Delta_2(b_1)\). Moreover, (37) decreases, while (38) increases with \(\Delta_2(b_1)\). According to Lemma 2, when (16) holds, we have \(\Delta_2(i) > \Delta_2(o)\). Thus, \(\beta_2^s\) is smaller, while \(\beta_2^w\) is larger, when firm one files for bankruptcy, \(b_1 = i\).

2. We provide the following numerical example supporting the statement. We assume that the profit \(\pi_j\) is given by (15) with \(\alpha = 20\), \(\delta = 0.05\), and \(\gamma = 0.9\), and that the remaining model parameters are: \(D_1 = \ldots\)
Proof of Proposition 4: 1. If firm two remains in the bankruptcy equilibrium when firm one files for bankruptcy, then the probability of bankruptcy $\beta_2(\mathcal{F}_2) = \beta_2(b_1)$ is given by (17). The expression (17) depends on firm one’s bankruptcy status only through $\Delta_2(b_1)$, and is increasing with $\Delta_2(b_1)$. According to Lemma 2, when (16) holds, we have $\Delta_2(i) > \Delta_2(o)$, which then implies that $\beta_2(i) > \beta_2(o)$. If firm one switches to the out-of-bankruptcy equilibrium when $b_1 = i$, then we have $0 = \beta_2(i) < \beta_2(o)$. Because we assume that (19) holds, from Lemma 3, it is not possible for firm two to be in the bankruptcy equilibrium when $b_1 = i$ and in the out-of-bankruptcy equilibrium when $b_1 = o$.

2. To prove the statement, we use the same numerical example as in the proof of Proposition 3. Specifically, we assume that $\pi_j$ is given by (15) with $\alpha = 20$, $\delta = 0.05$, and $\gamma = 0.9$, and also $D_1 = D_2 = 4$, $q_1 = q_2 = 0.3$, $\phi_1^s = \phi_2^s = 0.9$, and $\phi_1^w = \phi_2^w = 0.4$. With these parameters, we obtain $\beta_2(i) = 0.37$ while $\beta_2(o) = 0.38$. Thus, the probability of bankruptcy for firm two is smaller when firm one restructures in bankruptcy. □

Proof of Proposition 5: 1. As demonstrated in the proof of Lemma 1, firm one takes into account firm two’s response to firm one’s restructuring outcome because it may affect firm one’s competitive position in period three. The impact on firm one’s competitive position may exist if firm two’s expected competitive position is different depending on whether firm one restructures in or out of bankruptcy. In period three, firm two can be either non-operational, or bankrupt and operational, or not bankrupt and operational. The probability of firm two being non-operational equals $1 - E[\phi_2]$, where $E[\phi_2]$ can be evaluated as $(\phi_2^w + q_2(\phi_2^s - \phi_2^w))$ and is therefore independent of firm one’s restructuring outcome $b_1$. However, the probability $\hat{\beta}_2$ of firm two being bankrupt and operational (and hence the probability $(E[\phi_2] - \hat{\beta}_2)$ of firm two being not bankrupt and operational) may depend on firm one’s restructuring outcome. A difference between $\hat{\beta}_2(b_1 = o)$ and $\hat{\beta}_2(b_1 = i)$ is a necessary condition for feedback effect to exist. To verify that the difference between $\hat{\beta}_2(o)$
and $\hat{\beta}_2(i)$ is also sufficient, we evaluate firm one’s cost of bankruptcy $\Delta_1$ as

$$
\Delta_1 = E[\pi_1(o, b_2, p_2)|b_1 = o] - E[\pi_1(i, b_2, p_2)|b_1 = i] \\
= \hat{\beta}_2(o)\pi_1(o, i, y) + (1 - E[\phi_2])\pi_1(o, i, n) + (E[\phi_2] - \hat{\beta}_2(o))\pi_1(o, o, y) \\
- \hat{\beta}_2(i)\pi_1(i, i, y) - (1 - E[\phi_2])\pi_1(i, i, n) - (E[\phi_2] - \hat{\beta}_2(i))\pi_1(i, o, y) \\
= (1 - E[\phi_2])\Delta^n_1 + E[\phi_2]\Delta^o_1 + \hat{\beta}_2(o)(\Delta^o_1 - \Delta^n_1) \\
+ (\hat{\beta}_2(o) - \hat{\beta}_2(i))(\pi_1(i, i, y) - \pi_1(i, o, y)).
$$

(39)

Thus, the difference between $\hat{\beta}_2(o)$ and $\hat{\beta}_2(i)$ affects firm one’s cost of bankruptcy (and thus its bankruptcy probability, as well as bond and stock prices) as long as $\pi_1(i, i, y) \neq \pi_1(i, o, y)$, which is the case by assumption.

In what follows, we evaluate whether there is a difference separately for the following three cases: (i) firm two is in the out-of-bankruptcy equilibrium for both $b_1 = i$ and $b_1 = o$; (ii) firm two is in the bankruptcy equilibrium for both $b_1 = i$ and $b_1 = o$; and (iii) firm two switches from the bankruptcy to the out-of-bankruptcy equilibrium depending on $b_1$.

(i). Suppose firm two is in the out-of-bankruptcy equilibrium for both $b_1 = o$ and $b_1 = i$. Then, the probability of bankruptcy $\beta_2(b_1)$ equals zero for both $b_1 = o$ and $b_1 = i$, and thus the probability $\hat{\beta}_2$ of firm two being bankrupt and operational also equals zero for both $b_1 = o$ and $b_1 = i$. The lack of difference between $\hat{\beta}_2(o)$ and $\hat{\beta}_2(i)$ implies that there is no feedback effect.

(ii). Suppose firm two is in the bankruptcy equilibrium for both $b_1 = o$ and $b_1 = i$. Then, the probability $\hat{\beta}_2(b_1)$ of firm two being bankrupt and operational can be evaluated as follows.

$$
\hat{\beta}_2(b_1) = q_2\phi^o_2\beta^o_2(b_1) + (1 - q_2)\phi^o_2\beta^o_2(b_1) \\
= q_2\phi^o_2\frac{\ell_2D_2}{\phi^o_2\Delta_2(b_1) + \ell_2D_2} + (1 - q_2)\phi^o_2\frac{q_2\phi^o_2\Delta_2(b_1)}{(1 - q_2)(\phi^o_2\Delta_2(b_1) + \ell_2D_2)} \\
= q_2\phi^o_2.
$$

(40)

The above is independent of firm one’s restructuring outcome $b_1$, and thus there is no difference between $\hat{\beta}_2(o)$ and $\hat{\beta}_2(i)$. The lack of difference implies that there is no feedback effect.

(iii). If firm two is in the out-of-bankruptcy equilibrium for $b_1 = o$ and in the bankruptcy equilibrium for $b_1 = i$, then $\hat{\beta}_2(o)$ equals zero, while $\hat{\beta}_2(i)$ differs from zero and is given by (40). Similarly, if firm two
is in the out-of-bankruptcy equilibrium for \( b_1 = i \) and in the bankruptcy equilibrium for \( b_1 = o \), then \( \hat{\beta}_2(i) \) equals zero, while \( \hat{\beta}_2(o) \) differs from zero and is given by (40).

**Proof of Proposition 6:** The probability of bankruptcy for firm one is given by (18), which depends on firm two’s characteristics only through \( \Delta_1 \), and is increasing with \( \Delta_1 \). When firm two remains in the bankruptcy equilibrium whether or not firm one files for bankruptcy, we have \( \hat{\beta}_2(b_1) = q_2 \phi^s_2 \) according to (40), and thus expression (39) for \( \Delta_1 \) can be rewritten as

\[
\Delta_1 = (1 - E[\phi_2]) \Delta^o_1 + E[\phi_2] \Delta^o_1 + q_2 \phi^s_2 (\Delta^i_1 - \Delta^o_1).
\]

The above is decreasing in \( \phi^w_2 \) and \( \phi^s_2 \), and is increasing in \( q_2 \) if and only if (16) holds. □

**Proof of Proposition 7:** Firm one’s security price reactions to firm two’s restructuring reflect both its own restructuring outcome, \( b_1 \), and firm two’s restructuring outcome, \( b_2 \), since the reactions occur after both outcomes. Firm two’s security price reactions to firm one’s restructuring, however, only depend on \( b_1 \) since firm two’s restructuring outcome is not known at this time. In what follows, we first discuss the stock price reaction of firm two to firm one’s restructuring, followed by the stock price reactions of firm one to firm two’s restructuring. Finally, we turn to the bond price reactions of both firms.

To evaluate the reaction of firm two’s stock price to firm one’s restructuring outcome, we can consider the stock price of firm two immediately after the announcement of firm one’s restructuring outcome \( b_1 \). Because the prices immediately prior to the announcement are equal to the expectation of the corresponding price after announcement, a finding of a larger price for \( b_1 = i \) implies a positive price reaction, and finding a smaller price for \( b_1 = i \) implies a negative price reaction to the news about firm one’s bankruptcy. The stock price of firm two after bankruptcy negotiations of firm one can be evaluated as follows: In any equilibrium, a type \( s \) firm two receives the expected payoff \( S^s_2 \) whether or not it files for bankruptcy because type \( s \) always makes a fair offer, and bankruptcy costs, if any, are born by the debtholder. Thus, \( S^s_2 \) can be expressed as the expected payoff of type \( s \) when out of bankruptcy

\[
S^s_2(b_1) = \phi^s_2 E[\pi_2(o, b_1, p_1)|b_1] - D_2.
\]

In the bankruptcy equilibrium, a type \( w \) firm two receives the same equilibrium expected payoff \( S^w_2 \) whether or not it offers \( F^w_2 \) or \( F^s_2 \). Thus, \( S^w_2 \) can be expressed as expected payoff of type \( w \) when offering
and thus staying out of bankruptcy,

\[ S_2^w(b_1) = \phi_2^w E[\pi_2(o, b_1, p_1) | b_1] - D_2. \]

Using the above two expressions, we can express the bankruptcy equilibrium stock price \( S_2 \) of firm two as

\[
S_2(b_1) = q_2 S_2^w(b_1) + (1 - q_2) S_2^o(b_1)
\]

\[
= q_2 (\phi_2^w E[\pi_2(o, b_1, p_1) | b_1] - D_2) + (1 - q_2) (\phi_2^o E[\pi_2(o, b_1, p_1) | b_1] - D_2)
\]

\[
= \phi_2^w (1 - (1 - q_2) \ell_2) E[\pi_2(o, b_1, p_1) | b_1] - D_2
\]

\[
= \phi_2^w (1 - (1 - q_2) \ell_2) \left( E[\pi_1(b_1) \pi_j(o, b_1, y) + (1 - E[\phi_1|b_1]) \pi_1(o, b_1, n)) - D_2 \right)
\]

In the out-of-bankruptcy equilibrium, a type \( w \) firm two receives the expected profit of the firm net of the expected payment to the debtholder, which equals \( \phi_2^w F_2^2 = D_2 - \ell_2 D_2 \). Therefore, \( S_2^o \) can be expressed as

\[ S_2^o(b_1) = \phi_2^o E[\pi_2(o, b_1, p_1) | b_1] - D_2 (1 - \ell_2), \]

and thus, in the out-of-bankruptcy equilibrium,

\[
S_2(b_1) = \phi_2^o (1 - (1 - q_2) \ell_2) \left( E[\pi_1(b_1) \pi_j(o, b_1, y) + (1 - E[\phi_1|b_1]) \pi_1(o, b_1, n)) - (1 - (1 - q_2) \ell_2) D_2 \right).
\]

If firm two is in the bankruptcy or out-of-bankruptcy equilibrium for both \( b_1 = i \) and \( b_1 = o \), then

\[
\frac{S_2(i) - S_2(o)}{\phi_2^w (1 - (1 - q_2) \ell_2)} = E[\phi_1[i] \pi_2(o, i, y) - (\pi_2(o, i, n) - \pi_2(o, o, y)] - E[\phi_1[i] \pi_2(o, i, n) - \pi_2(o, i, y)]
\]

\[
= E[\phi_1[o] (\pi_2(o, i, n) - \pi_2(o, o, y)) - E[\phi_1[i] (\pi_2(o, i, n) - \pi_2(o, i, y))]
\]

\[
> \phi_2^w (\pi_2(o, i, n) - \pi_2(o, o, y)) - \pi_2(o, i, n) - \pi_2(o, i, y),
\]

and we obtain \( S_2(i) > S_2(o) \) from (20). If firm two is in the bankruptcy equilibrium when \( b_1 = o \) and in the out-of-bankruptcy equilibrium when \( b_1 = i \), then similar calculations obtain that

\[
\frac{S_2(i) - S_2(o)}{\phi_2^w (1 - (1 - q_2) \ell_2)} > \phi_2^w (\pi_2(o, i, n) - \pi_2(o, o, y)) - \pi_2(o, i, n) - \pi_2(o, i, y)) + \frac{(1 - q_2) \ell_2 D_2}{\phi_2^w (1 - (1 - q_2) \ell_2)}.
\]

The above implies that \( S_2(i) > S_2(o) \) due to (20) and \( (1 - q_2) \ell_2 D_2 > 0 \). Because we assume that (19) holds,
from Lemma 3, it is not possible for firm two to be in the bankruptcy equilibrium when \( b_1 = i \) and in the out-of-bankruptcy equilibrium when \( b_1 = o \).

For firm one, stock price after the news about restructuring inside or outside bankruptcy but prior to the firm two’s restructuring is given by (24) and (25) correspondingly. When (20) holds, (25) increases in response to the news that \( b_2 = i \) because the news affects only the expected profit term in (25), which becomes larger when conditioned on \( b_2 = i \). Expression (24) can be rewritten as

\[
S_1(i) = Pr(s|b_1 = i)\phi^s_1 E[\pi_1(o,b_2,c_2)|b_1 = o] + Pr(w|b_1 = i)\phi^w_1 E[\pi_1(i,b_2,c_2)|b_1 = o] - D_1.
\]

When (20) holds, the above also increases in response to the news that \( b_2 = i \).

We next turn to bond prices. We first derive the bond prices for both firms when firm \( j \) is either in the bankruptcy or out-of-bankruptcy equilibrium. Then, we obtain the proposition results by considering the price reactions to the news about the firm’s competitor.

Suppose firm two is in the bankruptcy equilibrium following the news \( b_1 \) about firm one’s restructuring outcome. If firm two is type \( w \) and offers \( F^w_2 \), which happens with probability \( (1 - q_2)(1 - e_2(b_1)) \), the debtholder receives \( D_2 \) in expectation. If firm two, however, offers \( F^s_2 \), the debtholder is indifferent between accepting and rejecting the offer. If the offer is accepted, the debtholder receives \( D_2 \) in expectation if the firm turns out to be type \( s \) (which happens with probability \( q_2 \)), and \( D_2 - \ell_2 D_2 \) in expectation if firm two turns out to be type \( w \) (which happens with probability \( (1 - q_2)e_2(b_1) \)). Thus, \( B_2(b_1) \) can be evaluated as

\[
B_2(b_1) = (1 - q_2)(1 - e_2(b_1))D_2 + q_2 D_2 + (1 - q_2)e_2(b_1)(D_2 - \ell_2 D_2) \\
= D_2 - q_2 \phi^s_2 \Delta_2(b_1),
\]

In the out-of-bankruptcy equilibrium, bond price \( B_2(b_1) \) for firm two after firm one’s restructuring can be evaluated as

\[
B_2(b_1) = D_2 - (1 - q_2)\ell_2 D_2.
\]

The above expressions imply that, if firm two is in the bankruptcy equilibrium for both \( b_1 = i \) and \( b_1 = o \), then the result follows from Lemma 2. Suppose next that firm two is in the out-of-bankruptcy equilibrium when \( b_1 = i \), but in the bankruptcy equilibrium when \( b_1 = o \). Then, according to Lemma 1, (12) does not
hold for \( b_1 = o \), implying that

\[ q_2 \phi_2^i \Delta_2(o) < (1 - q_2) \ell_2 D_2. \]

Therefore, \( B_2(i) < B_2(o) \) in this case. Finally, we obtain \( B_2(i) = B_2(o) \) if firm two is in the out-of-bankruptcy equilibrium for both \( b_1 = i \) and \( b_1 = o \) (as before, out-of-bankruptcy equilibrium when \( b_1 = o \) and bankruptcy equilibrium when \( b_1 = i \) is not possible according to Lemma 3).

For firm one, in the bankruptcy equilibrium, \( B_1(b_1) \) can be evaluated as follows.

\[ B_1(o) = D_1 - \Pr(w|b_1 = o) \ell_1 D_1, \tag{45} \]

and

\[ B_1(i) = D_1 - \Pr(s|b_1 = i) \phi_1^i \Delta_1. \tag{46} \]

Thus, \( B_1(o) \) does not react to the news about firm two’s restructuring, while \( B_1(i) \) reacts negatively to the news that \( b_2 = i \).

In the out-of-bankruptcy equilibrium, bond price \( B_1 \) for firm one restructuring can be evaluated as

\[ B_1 = D_1 - (1 - q_1) \ell_1 D_1, \tag{47} \]

which does not react to the news about firm two’s restructuring. \( \square \)

**Proof of Proposition 8:** Bankruptcy probabilities \( \beta_2(b_1) \) (firm two’s probability of bankruptcy), \( \beta_2^s(b_1) \) (firm two’s probability of bankruptcy conditional on being type \( s \)), and \( \beta_2^w(b_1) \) (firm two’s probability of bankruptcy conditional on being type \( w \)) are still given by (17), (37), and (38) respectively. Similarly, price of firm two’s debt is also still given by (43). Thus, as before, firm one’s bankruptcy negotiations affect firm two’s bankruptcy probabilities and price of debt only through \( \Delta_2(b_1) \), and \( \beta_2 \) and \( \beta_2^w \) are increasing in \( \Delta_2 \), while \( \beta_2^s \) and \( B_2 \) are decreasing in \( \Delta_2 \). However, Lemma 2 no longer holds given assumption (26). Instead, in this case, (16) implies \( \Delta_2(i) < \Delta_2(o) \), as we show below. Thus, \( \beta_2 \) and \( \beta_2^w \) are smaller, while \( \beta_2^s \) is larger, when firm one restructures in bankruptcy, \( b_1 = i \).

Similarly, firm two’s stock price is still given by (41). Thus, following the same steps as in the proof of
Proposition 7 under the assumption that firm two is in bankruptcy equilibrium, we obtain that $S_2(i) > S_2(o)$ when (20) holds.

We can show that $\Delta_2(i) < \Delta_2(o)$ as follows.

\[
\Delta_2(i) = \Delta_2^o + E[\phi_1 | b_1 = i](\Delta_2^i - \Delta_2^o) < \Delta_2^o + \phi_1^i(\Delta_2^o - \Delta_2^i) < \Delta_2^o + E[\phi_1 | b_1 = o](\Delta_2^o - \Delta_2^o) = \Delta_2(o),
\]

In the above, the first inequality follows from observing that $\Delta_2^o < \Delta_2^i$ according to (16), and that $E[\phi_1 | b_1 = i] < \phi_1^i$. The second inequality follows from (16). Finally, the last inequality follows from observing that $\Delta_2^o < \Delta_2^o$ according to (16), and that $\phi_1^o < E[\phi_1 | b_1 = i]$. □

**Proof of Proposition 9:** According to (31), firm two’s ex-ante probability $\beta_2$ of restructuring in bankruptcy is given by

\[
\beta_2(b_1) = q_2 \phi_2^s \beta_2^s(b_1) + (1 - q_2) \phi_2^w \beta_2^w(b_1) = q_2 \phi_2^s \phi_2^s \Delta_2(b_1) + \ell_2 D_2 + L_2 \phi_2^s \Delta_2(b_1) + \ell_2 D_2 + L_2.
\]

For a given set of beliefs, the direct cost $L_2$ affects $\beta_2$ only by directly entering the numerator and the denominator. To see that $\beta_2$ decreases with $L_2$, observe that, when $L_2 = 0$, the fraction is larger than one because $\phi_2^s > \phi_2^w$, and when $L_2$ approaches infinity, the fraction approaches one.

**Proof of Proposition 10:** Similar to the case of the proof of Proposition 5, in this case, the probability $\hat{\beta}_2(b_1)$ of firm two being bankrupt and operational can be evaluated as follows.

\[
\hat{\beta}_2(b_1) = q_2 \phi_2^s \hat{\beta}_2^s(b_1) + (1 - q_2) \phi_2^w \hat{\beta}_2^w(b_1) = q_2 \phi_2^s \phi_2^s \Delta_2(b_1) + \ell_2 D_2 + L_2 \phi_2^s \Delta_2(b_1) + \ell_2 D_2 + L_2.
\]

**Proof of Proposition 11:** The expressions for $\beta_2^s(b_1)$ (firm two’s probability of bankruptcy conditional on being type $s$) and $\beta_2(b_1)$ are given by (30) and (31) respectively, $\beta_2^w(b_1)$ (firm two’s probability of
bankruptcy conditional on being type \( w \) can be expressed as

\[
\beta_2^w(b_1) = e_2(b_1)d_2(b_1) = \frac{q_2(\phi_s^w\Delta_2(b_1) + L_2)}{(1-q_2)(\phi_s^w\Delta_2(b_1) + \ell_2D_2 + L_2)},
\]

and \( B_2(b_1) \) can be expressed as (the derivation closely follows that in (43) for the price of debt in the base model)

\[
B_2(b_1) = D_2 - q_2(L_2 - \phi_s^w\Delta_2(b_1)),
\]

Thus, as before, \( b_1 \) affects the probabilities of bankruptcy and price of debt only through \( \Delta_2(b_1) \), and \( \beta_2^w(b_1) \) and \( \beta_2(b_1) \) are increasing, while \( \beta_2^s(b_1) \) and \( B_2(b_1) \) are decreasing in \( \Delta_2(b_1) \). All of the proposition claims then obtain from observing that, from assumption (34), we have \( \Delta_2(i) > \Delta_2(o) \), which can be shown as follows:

\[
\Delta_2(i) = \Delta_2^o + E[\phi_1|b_1 = i](\Delta_2^o - \Delta_2^i) > \Delta_2^o + E[\phi_1|b_1 = i](\Delta_2^o - \Delta_2^i) > \Delta_2^o + E[\phi_1|b_1 = o](\Delta_2^o - \Delta_2^i) = \Delta_2(o),
\]

Similarly, the expression for \( S_2(b_1) \) is still given by (41). Thus, following the same steps as in the proof of Proposition 7 under the assumption that firm two is in bankruptcy equilibrium, but taking into account the new inequality (33), we obtain that \( S_2(i) < S_2(o) \). □
Figure 1: Equilibrium regions. This figure illustrates the parameter sets that support out-of-bankruptcy and bankruptcy equilibria for firms one and two for different values of the cost of bankruptcy ($\delta$) and level of debt mispricing ($\ell_1$). We vary $\ell_1 = (\phi_1^w - \phi_1^s) / \phi_1^s$ by changing $\phi_1^s$. The upper curve separating the parameter sets that support bankruptcy and out-of-bankruptcy equilibria for firm two delineates the two equilibrium regions conditional on firm one’s restructuring outside bankruptcy while the lower curve delineates firm two’s equilibrium regions conditional on firm one restructuring in bankruptcy. The part of the region where both firms are in bankruptcy equilibria lying above (below) the dashed curve is the parameter set where firm two’s bankruptcy probability is higher (lower) conditional on firm one being in bankruptcy. To generate the figure, we assume that firm j’s cash flow, $\pi_j$, is given by (15) with $\alpha = 20$ and $\gamma = 0.9$. The remaining model parameters are: $D_1 = D_2 = 4$, $q_1 = q_2 = 0.3$, $\phi_1^w = 0.3$, $\phi_2^w = 0.4$, and $\phi_2^s = 0.9$. 
Figure 2: Bankruptcy cost and the information signaled by restructuring outcomes. This figure illustrates how the posterior probability of firm one being type $s$ conditional on it restructuring outcome changes with the cost of financial distress ($\delta$). To generate the figure, we assume that firm $j$’s cash flow, $\pi_j$, is given by (15) with $\alpha = 20$ and $\gamma = 0.9$. The remaining model parameters are: $D_1 = D_2 = 4$, $q_1 = q_2 = 0.3$, $\phi^s_1 = \phi^s_2 = 0.9$, and $\phi^w_1 = \phi^w_2 = 0.4$. 


Figure 3: Mispricing and the information signaled by restructuring outcomes. This figure illustrates how the posterior probability of firm one being type $s$ conditional on it restructuring outcome changes with a key determinant of mispricing, $\ell_1$. We vary $\ell_1 = (\phi_1^s - \phi_1^w)/\phi_1^s$ by changing $\phi_1^s$. To generate the figure, we assume that firm $j$’s cash flow, $\pi_j$, is given by (15) with $\alpha = 20$, $\delta = 0.05$, and $\gamma = 0.9$. The remaining model parameters are: $D_1 = D_2 = 4$, $q_1 = q_2 = 0.3$, $\phi_1^w = 0.3$, $\phi_2^w = 0.4$, and $\phi_2^w = 0.9$. 

\[ \text{Probability} \]

Bankruptcy

Out of bankruptcy

$\ell_1$
Figure 4: Firm two’s stock price reaction to firm one’s restructuring. This figure illustrates how firm two’s stock price reacts to firm one’s restructuring outcome for different levels of the bankruptcy cost ($\delta$). To generate the figure, we assume that firm $j$’s cash flow, $\pi_j$, is given by (15) with $\alpha = 20$ and $\gamma = 0.9$. The remaining model parameters are: $D_1 = D_2 = 4$, $q_1 = 0.1$, $q_2 = 0.3$, $\phi_1^i = \phi_2^i = 0.9$, and $\phi_1^w = \phi_2^w = 0.4$. 
Figure 5: Firm two’s debt price reaction to firm one’s restructuring. This figure illustrates how the price of firm two’s debt reacts to firm one’s restructuring outcome for different levels of a key determinant of mispricing, $\ell_1$. We vary $\ell_1 = (\phi^i_1 - \phi^w_1)/\phi^s_1$ by changing $\phi^i_1$. To generate the figure, we assume that firm $j$’s cash flow, $\pi_j$, is given by (15) with $\alpha = 20$, $\delta = 0.05$, and $\gamma = 0.9$. The remaining model parameters are: $D_1 = D_2 = 4$, $q_1 = q_2 = 0.3$, $\phi^s_2 = 0.9$, and $\phi^w_1 = \phi^w_2 = 0.4$. 
Figure 6: A firm’s stock price reaction to its own restructuring. This figure illustrates how firm one’s stock price reacts to news of its bankruptcy for different levels of firm two’s competitiveness ($q_2$). Each set of two lines is generated using a given value of a key determinant of mispricing. The solid lines correspond to $\ell_1 = 0.1$, and the dashed lines correspond to $\ell_1 = 0.5$; we vary $\ell_1 = (\phi_1^s - \phi_1^w)/\phi_1^s$ by changing $\phi_1^s$. To generate the figure, we assume that firm $j$’s cash flow, $\pi_j$, is given by (15) with $\alpha = 20$, $\delta = 0.05$, and $\gamma = 0.9$. The remaining model parameters are: $D_1 = D_2 = 4$, $q_1 = 0.3$, $\phi_1^s = \phi_2^s = 0.9$, and $\phi_1^w = \phi_2^w = 0.4$. The breaks in the lines occur because at these values of $q_2$ multiple equilibria are possible.
Figure 7: The feedback effect for firm one’s restructuring. This figure illustrates how firm one’s indirect cost of bankruptcy changes in the presence of the direct bankruptcy cost $L$. The solid line corresponds to $L = 3$ and the dashed line correspond to $L = 0$. To generate the figure, we assume that firm $j$’s cash flow, $\pi_j$, is given by (15) with $\alpha = 20$ and $\gamma = 0.9$. The remaining model parameters are: $D_1 = D_2 = 4$, $q_1 = q_2 = 0.3$, $\phi_1^s = \phi_2^s = 0.9$, $\phi_1^w = 0.3$, and $\phi_2^w = 0.4$. 

54