Imperfect Competition, Debt, and Exit

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We show that an unprofitable firm in an oligopoly product market may motivate a favorable merger by committing to continue production, thereby dissipating industry profits. A sufficiently high level of debt financing makes the firm's production decision optimal for its equityholders. We show conditions for this production decision to be renegotiation-proof. Our analysis also applies to firms that are under bankruptcy protection, which enables them to finance continued operations with new debt. The empirical implications of our analysis relate takeovers of distressed firms to the nature of product market competition, the firms' debt policy, and the regulatory environment.

Can an unprofitable firm in an imperfectly competitive market motivate a merger with a healthy rival, if the unprofitable firm's next best alternative is to close its operations and liquidate? For the unprofitable firm, exit and liquidation rather than continued production better preserves shareholder value, but a merger could be an even more attractive alternative. Since redistributing the firm's assets to uses outside the industry would reduce capacity and raise profits for the remaining firms, it seems that a rival firm would want to buy the ailing firm and discontinue its operations. However, the issue for the potential acquirer is the credibility of the unprofitable firm's commitment to continue production, despite losses, and the consequent dissipation of industry profits. In this article, we show that a sufficiently levered capital structure can provide the necessary credibility to the unprofitable firm's threat of continuing production if there is no merger, and that this production decision can be renegotiation-proof.

Voluntary liquidations are optimal for shareholders when a firm's going-concern value is less than the value of its assets if sold to multiple acquirers. The evidence indicates that liquidating firms typically exhibit low growth, have been performing poorly, and have relatively little debt (Kim and Schatzberg, 1987, and Hite, Owers, and Rogers, 1987).[1] In contrast, Clark and Ofek (1994) report that in their sample of takeovers of distressed firms, the targets were relatively highly levered compared to their market rivals. Thus, although both sets of unprofitable firms exited, those that voluntarily liquidated had relatively low leverage compared to those that were acquired. Our analysis is consistent with this distinction in debt financing. Poorly performing firms that are successful in exiting through a merger with a rival firm have high leverage relative to those that cannot motivate such a takeover and must exit by voluntary liquidation. The role of debt in our model is well known—it serves as a credible commitment—but the specific application to market exit is new.

Our analysis focuses on a duopoly market in which two firms have different production costs. The high-cost firm is unprofitable (operationally distressed) under poor market conditions. In

[1]See also Akhigbe, Borde, and Whyte (2000) and Walker (2000) for additional evidence on intra-industry mergers.

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this situation, the poorly performing firm could exit by simply shutting down, but its equityholders prefer a profitable buyout by its low-cost rival. The low-cost firm might not want the acquisition, because it recognizes that duopoly competition would impose a greater burden on its higher-cost and ailing rival, which would prompt the rival to exit on its own.[2] Given that the high-cost firm will eventually shut down without a merger, we would expect the low-cost rival not to make an acquisition offer, but instead wait for its competitor to exit.

To motivate a merger, the high-cost firm must make credible its commitment not to exit and demonstrate that it will instead compete against its low-cost rival. In particular, the high-cost firm must ensure that its decision to continue production even if there is no merger is optimal. We show that production is optimal for the high-cost firm's equityholders if the firm uses sufficient debt financing, despite a consequent reduction in firm value. In this case, a rival's buyout offer that is acceptable to the high-cost firm's equityholders must provide them with at least as much as their expected payoff from continued production.

The use of debt financing by the high-cost firm signals its commitment to continue production, even if it is unprofitable. However, this commitment is only credible if the debt cannot be subsequently renegotiated by the high-cost firm's lenders so as to stop production in the absence of an acceptable buyout offer. That is, if there is no merger, the high-cost firm's debtholders will want the firm to preserve asset value by shutting down. Thus, to make debt a credible commitment to maintain production, the production decision must be renegotiation-proof. We show that this condition can be satisfied if the firm's lenders are relatively less informed than its insiders.

The results of our duopoly analysis generally carry over to oligopoly product markets. However, the explicit recognition of an oligopoly market introduces a new issue. In such a market, a firm has an incentive to free-ride the acquisition of a high-cost rival. That is, it prefers to wait for another firm to acquire the troubled competitor, thereby sharing the benefits of the merger without incurring the costs. Therefore, the fewer the number of competitors in an oligopoly (i.e., the more concentrated the industry), the less serious is the free-rider problem and the more effective is the high-cost firm's strategy of promoting a buyout by a rival. Furthermore, we show that if firms have different production costs, it is the lowest-cost firm that has the greatest incentive to acquire the troubled competitor.

One concern on the applicability of our model relates to antitrust restrictions. In the United States, mergers that increase market concentration may be approved under certain conditions. In our analysis, we first assume that the regulator will approve a merger of two rival firms only if the realized state of the market is bad enough that one of the merging firms would otherwise fail. Later, we show that such a regulatory policy is socially optimal. This regulatory policy seems consistent with the current merger guidelines. Saloner (1987, p. 166) observes that "The current merger guidelines allow a 'failing-firm defense' under which a merger will be allowed if it appears that one of the firms will otherwise go bankrupt." In our model, the firm that seeks a buyout has high-cost operations and is unprofitable if market conditions are bad.

Although our analysis requires the high-cost firm to be operationally distressed (but not necessarily financially distressed), it seems particularly applicable when the firm is under Chapter 11 bankruptcy protection. To the extent that such protection allows an ailing firm to issue new debt that lets it continue (or possibly even expand) its production, this protection

[2]Ghemawat and Nalebuff (1985) and Fudenberg and Tirole (1986) show that in a product market with excess capacity, the higher-cost firms are more likely to exit early.

provides an incentive for its healthy rival to acquire the firm and force its exit.[3]

Our article relates to a growing literature that examines the strategic interaction of product markets and financial decisions. Brander and Lewis (1986) show that in an oligopoly product market under Cournot quantity competition, firms may use debt financing to facilitate an aggressive output decision.[4] Our article differs in that given the decision to produce, firm output is independent of the debt level, and our results would be qualitatively unchanged under price or quantity competition. Saloner (1987) relates predation to mergers, showing that the acquiring firm can expand its output to signal that it is a low-cost firm and thereby improve the takeover terms.

Harris and Raviv (1988) and Stulz (1988) examine the role of debt in mergers and acquisitions and show that potential targets can use debt as a defense against hostile takeover attempts. These studies' findings suggest a relation between the level of debt and the likelihood of a takeover that is opposite to what our model predicts. This difference results from our focus on an imperfectly competitive product market and on targets that are operationally distressed.

We organize the article as follows: In Section I, we set up duopoly competition in the product market. In Section II, we analyze how debt can be used strategically by a high-cost firm to motivate a buyout by its low-cost rival, and we examine the optimal regulatory policy concerning this buyout. In Section III, we extend the analysis to an oligopoly product market. We conclude in Section IV with a discussion of the empirical implications of our analysis. The Appendix contains the proofs of all propositions.

I. Product Market Competition

We consider a duopoly product market in which two firms, 1 and 2, engage in Cournot quantity competition. The product market covers two dates. At date $t = 1$, each firm incurs both fixed and variable costs to produce output. At date $t = 2$, market demand for the product is realized, and so are firm profits. We assume that the two firms have an identical variable production cost—$c > 0$ per unit output—but differ in their fixed production costs—$f_i > 0$ for firm $i \in \{1,2\}$—where firm 1 is the higher-cost producer, i.e., $f_1 > f_2$. Each firm incurs the fixed cost only if it produces a positive output. By not producing, i.e., by exiting the market, a firm avoids both fixed and variable production costs.

Product market demand is linear, but with uncertainty concerning the condition of the market being either "good" or "bad." This particular form of uncertainty is unimportant. What matters is that there is uncertainty of some sort that affects the profitability of the two firms. A priori, the two possible states of the market are equally probable. If the market is good, product price at $t = 2$ is:

$$p = y - q_1 - q_2, \tag{1}$$

where $q_i \geq 0$ is the output level chosen by firm $i \in \{1,2\}$ at $t = 1$, and $y > 0$ is a parameter indicating overall product demand. If the market is bad, product price at $t = 2$ is:

[3]The effect of Chapter 11 protection on product market competition is an interesting issue. In the WorldCom bankruptcy case, the firm's competitors complained about being at a competitive disadvantage due to the bankruptcy court's treatment of WorldCom. Rival firms did not offer to buy WorldCom possibly because they were distressed as well (Shleifer and Vishny, 1992) but also possibly because of the free-rider problem analyzed later.

[4]See also Allen (1986), Dasgupta and Titman (1998), Gertner, Gibbons, and Scharfstein (1988), Maksimovic (1988, 1990), Maksimovic and Titman (1991), and Titman (1984).

$$p = \begin{cases} y - q_1 - q_2 & \text{with probability } \theta, \\ 0 & \text{with probability } 1-\theta. \end{cases} \tag{2}$$

The uncertainty about the state of the market is resolved at $t = 1$ and the realized state is revealed to the firms' insiders who represent the interests of their equityholders.

We first examine the firms' Cournot-Nash equilibrium outputs and profits in the absence of any strategic considerations. If the market is good and firm $j \in \{1,2\}$ chooses output $q_j > 0$, the profit function of firm $i \in \{1,2\}$, $i \neq j$, is:

$$\pi_i^g = (y - q_i - q_j)q_i - cq_i - f_i. \tag{3}$$

The first-order conditions imply that firm i's equilibrium output is $q_i^g = (y - c)/3$, and its equilibrium profit at $t = 2$ is:

$$\pi_i^{g*} = \frac{(y-c)^2}{9} - f_i \tag{4}$$

If the market is bad, firm i's expected profit function is:

$$\pi_i^b = \theta(y - q_i - q_j)q_i - cq_i - f_i. \tag{5}$$

The firm's equilibrium output is $q_i^b = (\theta y - c)/(3\theta)$, and its equilibrium profit is:

$$\pi_i^{b*} = \frac{(\theta y-c)^2}{9\theta} - f_i \tag{6}$$

To ensure that quantities produced are positive regardless of market condition, we assume $c/y < \theta < 1$. We also assume that each firm's production is more profitable if the market is good than if it is bad, i.e., $\pi_i^{g*} > \pi_i^{b*}$. Furthermore, by assuming:

$$f_2 < \frac{(\theta y-c)^2}{9\theta} < f_1 < \frac{(y-c)^2}{9} \tag{7}$$

we have π_1^{g*}, π_2^{g*}, and π_2^{b*} positive, but π_1^{b*} negative. That is, firm 2's production is profitable under either market condition, but firm 1's is profitable only when the market is good. Therefore, in the absence of strategic considerations, firm 1 will shut down production (i.e., exit) when the market is bad.[5]

For firm 1, exiting the product market is preferable to producing in the bad market, but better still could be an exit by way of a merger with firm 2. If firm 2 acquires firm 1 and subsequently shuts it down, the surviving firm 2's profit in the good market with the optimal output $q_m^g = (y - c)/2$ is:

[5]If firm insiders obtained private control benefits, they would continue production even to the detriment of firm shareholders. See, for examples, Kanatas and Qi, (2001, 2004).

$$\Pi^g = \frac{(y-c)^2}{4} - f_2 \tag{8}$$

and in the bad market with the output $q_m{}^b = (\theta y - c)/(2\theta)$ is:

$$\Pi^b = \frac{(\theta y - c)^2}{4\theta} - f_2 \tag{9}$$

The above profits, Π^g and Π^b, exceed those realized if both firms compete in the product market. They are also greater than those obtained if firm 1, after the merger with firm 2, were to produce some output (instead of shutting down completely).[6]

Does firm 2 want to merge with firm 1 if firm 1 is all-equity financed? Not if the state of the market is bad. When the market is good, firm 1 will be profitable and therefore will not exit the product market. In this case, barring regulatory constraints, firm 2 will want to acquire firm 1 and shut it down in order to enjoy the greater industry profits. In contrast, when the market is bad, firm 1's production will be unprofitable, and if there is no buyout by firm 2, firm 1 will voluntarily shut down. Anticipating this exit by firm 1, firm 2 will not agree to a buyout that firm 1 would prefer to its voluntary exit.

Can firm 1 motivate its acquisition by firm 2 by threatening to continue production when the market is bad? Such a threat is generally not credible. As long as firm 2 refuses to merge, firm 1 will incur a loss to continue production. Thus, when the market is bad, firm 2 will not merge with firm 1, knowing that firm 1 will exit on its own. To have firm 2 seriously consider a merger, firm 1's threat to continue production must be credible, i.e., firm 1's decision to produce if there is no merger must be optimal for its shareholders. This condition is satisfied, as we will see, if firm 1 uses debt strategically.

II. Strategic Use of Debt

We now examine the strategic use of debt by firm 1 to motivate a merger with firm 2. We will develop an equilibrium model of debt financing after providing an illustration of our basic intuition.

A. An Illustration

For this illustration, we make additional simplifications and assume away a number of important issues. We assume that the realized market condition is publicly observed at $t = 1$, and that it is bad (the good market case is not interesting here because firm 2 will want to merge with firm 1). In the bad market, firm 2 does not want to merge with firm 1 if firm 1 uses no debt. To examine how firm 1's debt financing might change firm 2's no-merger stance, we assume that firm 1 has at $t = 1$ a non-renegotiable debt obligation of $D_1 > 0$ that must be paid off at $t = 2$. Furthermore, firm 1 has accumulated or raised cash of $h_1 > 0$ to finance its production. For simplicity, the amount h_1 is just enough to cover firm 1's production costs if production takes place, and it is also sufficient to repay the debt D_1 if production does not take place.

[6]Gaudet and Salant (1991) show that a horizontal merger in an oligopoly market can cause the merged firms' combined profits to fall below what they would have been without the merger. This possibility does not arise here because the firms differ only in their fixed costs.

With the outstanding debt, if firm 1 chooses to produce rather than to exit in the bad market, its output q_1 maximizes its shareholders' expected payoff from duopoly competition:

$$\bar{\pi}_1^b = \theta[(y - q_1 - q_2)q_1 - D_1] - cq_1 - f_1 + h_1 \tag{10}$$

We assume $D_1 < (y - q_1 - q_2)q_1$ throughout the model. We also assume that firm 2 is all-equity financed (this assumption is important here but not so in our equilibrium analysis). Thus, firm 2's payoff function is given by Equation (5). The first-order conditions imply that the firms' Cournot-Nash equilibrium outputs are $\bar{q}_1^b = \bar{q}_2^b = (\theta y - c)/(3\theta)$, and their equilibrium payoffs are:

$$\bar{\pi}_1^{b*} = \frac{(\theta y - c)^2}{9\theta} - f_1 - \theta D_1 + h_1, \tag{11}$$

$$\bar{\pi}_2^{b*} = \frac{(\theta y - c)^2}{9\theta} - f_2 \tag{12}$$

Instead of producing, firm 1 can choose to exit the market and obtain the payoff $h_1 - D_1$ for its shareholders. Therefore, firm 1 prefers production to exit if $\bar{\pi}_1^{b*} > h_1 - D_1$. That is, if:

$$D_1 > \frac{-1}{1-\theta}\left[\frac{(\theta y - c)^2}{9\theta} - f_1\right] > 0. \tag{13}$$

The last inequality above follows from Condition (7).

Since the debt obligation causes firm 1's shareholders to prefer production even in the bad market, the firm's threat to produce if there is no buyout becomes credible. Thus, firm 2 will want to acquire firm 1 if firm 2's subsequent monopoly profits minus the buyout costs, $\Pi^b + h_1 - \bar{\pi}_1^{b*} - D_1$, are greater than its profits stemming from duopoly competition, $\bar{\pi}_2^{b*}$. That is, if:

$$D_1 < \frac{1}{1-\theta}\left[\frac{(\theta y - c)^2}{36\theta} + f_1\right] \tag{14}$$

Inspecting Conditions (13) and (14), we see that the set of D_1 that satisfies both is not empty. We summarize below the basic result of our illustration.

Proposition 1: *If firm 1 has a non-renegotiable debt obligation of D_1 and if this debt satisfies:*

$$\frac{-1}{1-\theta}\left[\frac{(\theta y - c)^2}{9\theta} - f_1\right] < D_1 < \frac{1}{1-\theta}\left[\frac{(\theta y - c)^2}{36\theta} + f_1\right], \tag{15}$$

then in the bad market, firm 1 is able to motivate firm 2 to acquire it and subsequently shut it down.

B. Equilibrium Debt Financing

We now develop an equilibrium model of debt financing by firm 1 by making the firm's debt level endogenous and by allowing debt to be renegotiable if there is no merger. To do so, we introduce an initial date, $t = 0$, when firm 1 chooses to borrow $B_1 \geq 0$ from a competitive debt market (with zero discounting) and promises to repay its lenders $D_1 \geq 0$ at $t = 2$. If firm 1 produces $q_1 > 0$ at $t = 1$, its total production costs are $cq_1 + f_1$, which are financed by the borrowing B_1 and, if needed, by an additional equity contribution of $cq_1 + f_1 - B_1$.

The critical uncertainty that affects firm profitability, the good or bad state of the market, is now only privately revealed to the firms' insiders (representing only the shareholder interests). To maintain the informational asymmetry between firm insiders and outsiders (lenders), we also assume that the amount of equity contribution, if any, by firm 1's shareholders is publicly unobservable at $t = 1$.[7] We need this informational asymmetry because debt is renegotiable. However, with renegotiable debt, our earlier assumption that the low-cost firm 2 is all-equity financed is not important, because debt financing by firm 2 no longer has any strategic value. Unlike firm 1's, firm 2's production is profitable in both good and bad states. Thus, firm 2 does not exit the product market. Once firm 1 has credibly committed to continue production, it is in the interests of all firm 2 claimholders to agree to make an acceptable offer to acquire firm 1, regardless of any prior commitment to the contrary.

An important aspect of our equilibrium analysis concerns regulatory restrictions on the merger of rival firms. It is possible that a competition-reducing merger will be blocked by the regulator if it reduces social welfare. To examine implications of such antitrust legislation, we assume that a proposed merger of firms 1 and 2 must obtain regulatory approval, and when a merger agreement is submitted for approval, the regulator learns that the realized state is good or bad. Our analysis first assumes that the regulator will approve the merger only when the realized market condition is bad (and so firm 1's production will be unprofitable). We then establish conditions for this regulatory policy to be socially optimal.

In our model, a merger agreement reached by the two firms (i.e., by their insiders) is binding on both parties unless it is blocked by the regulator. Then, if there is a merger agreement that is approved by the regulator, the lender must infer that the state is bad. This inference by firm 1's lenders does not affect the merger, as long as the agreed debt buyout price is fair, given the lenders' updated beliefs. If the price were not fair, firm 1's insiders would not have agreed to the merger in the first place, knowing that its lenders will not accept an inadequate buyout price. However, if a merger agreement is rejected by the regulator, firm 1's lenders must infer that the market is good, and both firms will certainly continue production.

What is crucial are lender beliefs about the state of the market if there is no merger agreement between the two firms. In this situation, firm 1's lenders cannot rationally infer that the market is bad. Their beliefs also cannot be influenced by a unilateral offer made by firm 2 that has not been agreed to by firm 1, for otherwise, firm 2 is able to make a strategic merger offer even when the market is good—an offer it knows will be rejected by firm 1, given the regulatory restriction. Since we will establish that in a pure strategy equilibrium, the two firms will reach a merger agreement when the market is bad, the rational beliefs of firm 1's lenders if there is no merger agreement must be that the market is good.

Given firm 1's choice of debt financing $\{B_1, D_1\}$ and the realized market condition, we derive

[7]By this assumption, we capture the setting in which at least some of the necessary funds are from internal sources, not readily observable by outsiders.

the firms' Cournot-Nash equilibrium outputs and profits. If the market is good, firm 1 shareholders' expected profit from product market competition is:

$$\hat{\pi}_1^g = (y - q_1 - q_2)q_1 - cq_1 - f_1 - D_1 + B_1 \tag{16}$$

Using no debt, firm 2's profit function is the same as given by Equation (3). Thus, the firms' equilibrium outputs are $\hat{q}_1^b = \hat{q}_2^b = (\theta y - c)/(3\theta)$, and their equilibrium profits are:

$$\hat{\pi}_1^{g*} = \frac{(y-c)^2}{9} - f_1 - D_1 + B_1 \tag{17}$$

$$\hat{\pi}_2^{g*} = \frac{(y-c)^2}{9} - f_2 > 0 \tag{18}$$

If the market is bad, firm 1's debt financing results in the following expected profit for its shareholders:

$$\hat{\pi}_1^b = \theta[(y - q_1 - q_2)q_1 - D_1] - cq_1 - f_1 + B_1 \tag{19}$$

Firm 2's profit function is given by Equation (5). In this situation, the firms' equilibrium outputs are $\hat{q}_1^b = \hat{q}_2^b = (\theta y - c)/(3\theta)$, and their equilibrium profits are:

$$\hat{\pi}_1^{b*} = \frac{(\theta y - c)^2}{9\theta} - f_1 - \theta D_1 + B_1 \tag{20}$$

$$\hat{\pi}_2^{b*} = \frac{(\theta y - c)^2}{9\theta} - f_2 > 0 \tag{21}$$

The production profits for firm 1's shareholders, $\hat{\pi}_1^{g*}$ and $\hat{\pi}_1^{b*}$, clearly depend on its choice of debt financing, $\{B_1, D_1\}$, and these payoffs can be positive even when the market is bad. Indeed, given production, firm 1 will pay back its debtholders D_1 with certainty if the market is good, but only with probability θ if the market is bad. The expected debt payment implies that firm 1's $t = 0$ borrowing satisfies $B_1 = (1 + \theta)D_1/2$. Therefore, it is possible for a choice of $\{B_1, D_1\}$ to result in $\hat{\pi}_1^{g*} \geq 0$ and $\hat{\pi}_1^{b*} > 0$. If $\hat{\pi}_1^{g*} = 0$ firm 1 will still produce in the good market, because production does not make its shareholders worse off but does make its debtholders better off.

With debt being renegotiable, an important question is whether firm 1's debtholders can motivate its insiders to shut down in the bad market, if there is no merger. The lenders want production to stop when the market is bad, but not when it is good. Knowing this conflict, firm 1's shareholders can choose a particular level of debt that will prevent the debtholders from being able to make an offer that will stop production only when the market is bad, because such an offer will also stop production when the market is good. This level of debt ensures that firm 1's production decision is renegotiation-proof.

Proposition 2: *Suppose,*

$$\frac{(\theta y-c)^2}{9\theta} < f_1 < \frac{(y-c)^2}{18} + \frac{(\theta y-c)^2}{18\theta} \tag{22}$$

Then, if firm 1's choice of debt financing, $\{B_1, D_1\}$, satisfies:

$$\frac{1}{1-\theta}\left[\frac{(y-c)^2}{9} - \frac{(\theta y-c)^2}{9\theta}\right] < D_1 \le \frac{2}{1-\theta}\left[\frac{(y-c)^2}{9} - f_1\right] \tag{23}$$

and $B_1 = (1+\theta)D_1/2$, we have $\hat{\pi}_1^{b*} > \hat{\pi}_1^{g*} \ge 0$. In this situation, if there is no merger, firm 1's shareholders choose production even when the market is bad, and this production decision is renegotiation-proof.

Condition (23) characterizes the range of firm 1's debt that ensures that the firm's production decision is renegotiation-proof if there is no merger. Condition (22) on firm 1's fixed production cost f_1, incorporating the earlier profitability Condition (7), ensures that the set of D_1 characterized by Condition (23) is not empty. The lower bound in Condition (23) ensures $\hat{\pi}_1^{b*} > \hat{\pi}_1^{g*}$ and the upper bound guarantees $\hat{\pi}_1^{g*} \ge 0$.

We now examine the conditions needed for firms 1 and 2 to reach an equilibrium merger agreement. In general, either firm may get to make a take-it-or-leave-it merger proposal to the other. We assume that firm 1 gets this opportunity with probability $\alpha \in (0,1)$, and firm 2 gets it with probability $1-\alpha$. Parameter α captures the relative bargaining power of firm 1 in merger negotiations. Such negotiations are between the firms' insiders and are unobservable to outsiders. Although firm 2 wants to publicize such negotiations, it is unable to credibly commit itself not to mislead firm 1's lenders into believing that the market is bad when it is actually good. Since the regulatory constraint prevents a merger when the market is good, our equilibrium analysis focuses on the two firms reaching a merger agreement when their insiders learn that the market is bad. If the two firms merge in this situation, we let s_{i1} denote the agreed buyout price for firm 1's equity and b_{i1} for its debt if firm $i \in \{1,2\}$ makes the take-it-or-leave-it merger proposal. Given this agreement, firm 2's payoff is $\Pi^b + B_1 - s_{i1} - b_{i1}$, where Π^b is the post-merger industry profits.

A collection of firm 1's debt financing at $t=0$, $\{B_1, D_1\}$, firm 2's buyout prices for firm 1 at $t=1$, s_{i1} and b_{i1} for both $i \in \{1,2\}$, and firm 1 lenders' beliefs that the market is bad if there is (if there is not) a merger agreement, ϕ^b (ψ^b), characterizes a Perfect Bayesian Nash Equilibrium if the following conditions are satisfied.

(A) For both $i \in \{1,2\}$, given firm 1 lenders' acceptance of the buyout price b_{i1}, firm 1's shareholders are no worse off if firm 2 acquires firm 1 at the buyout prices than if the two firms compete in the product market, i.e.:

$$s_{i1} \ge \hat{\pi}_1^{b*} \tag{24}$$

(B) For both $i \in \{1,2\}$, given the buyout prices $s_{i1} + b_{i1}$ for firm 1, firm 2 is no worse off if the buyout takes place than if it does not and the two firms compete in the product market, i.e.,

$$\Pi^b + B_1 - s_{i1} - b_{i1} \geq \hat{\pi}_2^{b*} \tag{25}$$

(C) Firm 1 lenders' beliefs that the market is bad, conditioned on that there is and that there is not a merger agreement between the two firms are given by:

$$\phi^b = \Pr(\text{The market is bad}|\text{There is a merger agreement}) = 1, \tag{26}$$

$$\psi^b = \Pr(\text{The market is bad}|\text{There is no merger agreement}) = 0. \tag{27}$$

(D) Given the updated beliefs of firm 1's lenders if there is no merger agreement, firm 1 chooses production over exit, and this production decision is renegotiation-proof. Following Proposition 2, we require:

$$\hat{\pi}_1^{b*} > \hat{\pi}_1^{g*} \geq 0 \tag{28}$$

(E) For both $i \in \{1,2\}$, given their updated beliefs if there is a merger agreement, firm 1's lenders accept the debt buyout price b_{i1}. Thus, this price must be no less than the debt's expected repayment from production, i.e., $b_{i1} \geq \theta D_1$.[8] However, to maximize their own payoff, firm 1's shareholders choose only a minimally acceptable price for the debt, i.e.:

$$b_{i1} = \theta D_1. \tag{29}$$

(F) Firm 1's shareholders choose debt financing $\{B_1, D_1\}$ at $t = 0$, if they are better off with the debt than without it and if the debt is fairly priced. That is, firm 1's shareholders choose $\{B_1, D_1\}$ to:

$$\text{maximize } 0.5\left[\hat{\pi}_1^{g*} + \alpha s_{11} + (1-\alpha)s_{21}\right] \tag{30}$$

$$\text{subject to, } 0.5\left[\hat{\pi}_1^{g*} + \alpha s_{11} + (1-\alpha)s_{21}\right] > 0.5\pi_1^{g*} \tag{31}$$

$$B_1 = 0.5\left[D_1 + \alpha b_{11} + (1-\alpha)b_{21}\right] \tag{32}$$

Proposition 3: *Suppose that f_1 satisfies Condition (22) and that the market is privately revealed to firms 1 and 2's insiders to be bad. Then, there exists a $\theta^* \in (c/y,1)$, an $\alpha^* \in (0,1)$, and an $f_2^* < (\theta y - c)^2/(9\theta)$, such that for all $\theta > \theta^*$, $\alpha > \alpha^*$, and $f_2 \in (f_2^*, (\theta y - c)^2/(9\theta))$, the collection of firm 1's choice of:*

$$D_1 = \frac{2}{1-\theta}\left[\frac{(y-c)^2}{9} - f_1\right] > 0 \tag{33}$$

and $B_1 = (1 + \theta)D_1/2 > 0$, firm 2's buyout prices for firm 1 of $s_{11} = \Pi^b + B_1 - \theta D_1 - \hat{\pi}_2^{b*} > 0$,

[8]With a merger agreement in place, firm 1's lenders know that the market is bad. Therefore, if they were to reject the merger, the best they could get from continued production or from debt renegotiation at this point would be θD_1.

$s_{21} = \hat{\pi}_1^{b*} > 0$, and $b_{11} = b_{21} = \theta D_1$, and firm 1 lenders' updated beliefs $\phi^b = 1$ and $\psi^b = 0$, is a Perfect Bayesian Nash Equilibrium, and this merger agreement will be approved by the regulator.

Proposition 3 establishes an equilibrium level of debt financing by firm 1. The condition on firm 1's fixed cost f_1 is the same one in Proposition 2, which ensures that firm 1's production decision in the bad market is renegotiation-proof if there is no merger. The restriction on firm 1's bargaining power, $\alpha > \alpha^*$, guarantees that firm 1's share of the merger gains is large enough to make the exit-by-merger strategy worthwhile. To ensure $a^* < 1$, we need a restriction on firm 2's cost, $f_2 > f_2^*$. Then, to ensure $f_2^* < (\theta y - c)^2/(9\theta)$, required by Condition (7), we need $\theta > \theta^*$. We note that the equilibrium debt level D_1 satisfies Condition (23), and the equilibrium values of B_1 and b_{i1} guarantee that the debt is fairly priced at $t = 0$, and at $t = 1$ if the market is bad. On the other hand, the equilibrium buyout price for firm 1's equity satisfies the equality of Condition (24) if firm 2 makes the (take-it-or-leave-it) merger offer, but satisfies the equality of Condition (25) if firm 1 makes it. Intuitively, the firm that gets to make the merger offer has all the bargaining power and therefore will offer only the minimally acceptable price.

C. Optimal Regulatory Policy

We have thus far assumed that the regulator approves the merger of firms 1 and 2 only when the realized state of the market is bad. We now establish conditions to ensure that this regulatory policy is socially optimal.

We first consider the welfare implication of the merger when the market is good. In this situation, duopoly competition has firm $i \in \{1,2\}$ produce $q_i^g = (y - c)/3$ and sell the output at price $(y + 2c)/3$. Since y is the lowest price with no demand, the consumer surplus is:

$$\int_{\frac{y+2c}{3}}^{y} (y - p)dp = \frac{2(y-c)^2}{9} \tag{34}$$

The producer surplus is the two firms' profits, $\pi_1^{g*} + \pi_2^{g*}$, with π_i^{g*} given by Equation (4). Thus, with no merger in the good market, the total consumer and producer surplus is:

$$R_d^g = \frac{4(y-c)^2}{9} - f_1 - f_2 \tag{35}$$

If the two firms merge, the surviving firm's output is $q_m^g = (y - c)/2$ in the good market, and the product price is $(y + c)/2$. The consumer surplus is now:

$$\int_{\frac{y+c}{2}}^{y} (y - p)dp = \frac{(y-c)^2}{8} \tag{36}$$

The producer surplus is the post-merger profit Π^g, given by Equation (8). Thus, the total consumer and producer surplus if the two firms merge in the good market is:

$$R_m^g = \frac{3(y-c)^2}{8} - f_2 \tag{37}$$

Therefore, when the market is good, the merger of the two firms reduces social welfare if $R_m^g < R_d^g$. That is, if:

$$f_1 < \frac{5(y-c)^2}{72} \tag{38}$$

When the market is bad, duopoly competition has firm $i \in \{1,2\}$ produce $q_i^b = (\theta y - c)/(3\theta)$, and sell the output at price $(\theta y + 2c)/(3\theta)$ with probability θ and zero with probability $1 - \theta$. Now, the expected consumer surplus is:

$$\theta \int_{\frac{\theta y+2c}{3\theta}}^{y} (y-p)dp = \frac{2(\theta y-c)^2}{9\theta} \tag{39}$$

The producer surplus, given production by both firms, is the firms' profits, $\pi_1^{b*} + \pi_2^{b*}$, with π_i^{b*} given by Equation (6). In this case, duopoly competition results in the total surplus of:

$$R_d^b = \frac{4(\theta y-c)^2}{9\theta} - f_1 - f_2 \tag{40}$$

If the two firms merge in the bad market, the surviving firm produces $q_m^b = (\theta y - c)/(2\theta)$. The product price is $(\theta y + c)/(2\theta)$ with probability θ and zero with probability $1 - \theta$. Then the consumer surplus is:

$$\theta \int_{\frac{\theta y+c}{2\theta}}^{y} (y-p)dp = \frac{(\theta y-c)^2}{8\theta} \tag{41}$$

Since the producer surplus is the surviving firm's profit Π^b, given by Equation (9), the total consumer and producer surplus is:

$$R_m^b = \frac{3(\theta y-c)^2}{8\theta} - f_2 \tag{42}$$

Therefore, the merger of the two firms in the bad market increases social welfare if $R_m^b > R_d^b$. That is, if:

$$f_1 > \frac{5(\theta y-c)^2}{72\theta} \tag{43}$$

If both Conditions (38) and (43) are satisfied, it is optimal for the regulator to approve the merger of firms 1 and 2 when and only when the realized market condition is bad. Inspecting these two conditions, we see that the set of f_1 that satisfies both is not empty for all $\theta \in (c/y,1)$.

To incorporate the optimal regulatory policy into our earlier analysis of equilibrium debt financing, we must ensure that the two additional restrictions on f_1, i.e., Conditions (38) and (43), do not render infeasible the earlier Conditions (7) and (22). Inspecting all these conditions, we replace Conditions (7) and (22) with the stronger ones below:

$$f_2 < \frac{(\theta y - c)^2}{9\theta} < f_1 < \frac{5(y-c)^2}{72} \tag{44}$$

$$\frac{(\theta y - c)^2}{9\theta} < f_1 < \min\left[\frac{5(y-c)^2}{72}, \frac{(y-c)^2}{18} + \frac{(\theta y - c)^2}{18\theta}\right] \tag{45}$$

Since $(\theta y - c)^2/(9\theta) < (y-c)^2/18 + (\theta y - c)^2/(18\theta)$ for all $\theta \in (c/y, 1)$, to ensure that f_1 satisfying Conditions (44) and (45) is not empty, we need only:

$$\frac{(\theta y - c)^2}{9\theta} < \frac{5(y-c)^2}{72} \tag{46}$$

Letting θ^{**} be a critical value of θ that makes the above condition an equality, we have $\theta^{**} > c/y$. For all $\theta < \theta^{**}$, Condition (46) is satisfied. What remains is to show that the new critical value θ^{**} is greater than the earlier θ^{*} in Proposition 3.

Proposition 4: *We have $\theta^{**} > \theta^{*}$. Then, for all $\theta \in (\theta^{*}, \theta^{**})$, by replacing Conditions (7) and (22) with the stronger (44) and (45), respectively, it follows that the results of Propositions 2 and 3 remain unchanged even with the endogenous regulatory policy.*

Therefore, our earlier equilibrium analysis remains qualitatively unchanged, and so do the results. However, the earlier-assumed regulatory policy on the merger of two rival firms is now socially optimal.[9]

III. Exit in Oligopoly

In this section, we extend our analysis to a more general oligopoly product market with $\eta > 2$ firms, but with a key distinction. Unlike a duopoly, there is a free-rider problem in an oligopoly. That is, a firm in an oligopoly prefers that a competitor acquire the high-cost rival, thereby sharing in the benefits of the merger without incurring the costs.

As in the duopoly case, we let q_i, $i \in \{1,2,...,\eta\}$, denote the output chosen by firm i at $t = 1$. If the market is good, product price at $t = 2$ in the h-firm oligopoly is:

$$p = y - \sum_{i=1}^{\eta} q_i \tag{47}$$

If the market is bad, the price is:

[9]See Farrell and Shapiro (1990) for a more general analysis of the relation between social welfare and industry concentration.

$$p = \begin{cases} y - \sum_{i=1}^{\eta} q_i & \text{with probability } \theta \\ 0 & \text{with probability } 1-\theta \end{cases} \tag{48}$$

As before, the market being good or bad is equally probable, and the realized market condition is only privately revealed to the firms' insiders at $t = 1$. Also, all firms have the same unit production cost $c \in (0, \theta y)$, but differ in their fixed costs, which are $f_i > 0$ for firm i. Then, if the market is good, the Cournot-Nash equilibrium output of firm $i \in \{1,2,...,\eta\}$ is $q_i^g = (y - c)/(1 + \eta)$, and its equilibrium profit is:

$$\pi_i^{g*} = \frac{(y-c)^2}{(1+\eta)^2} - f_i \tag{49}$$

If the market is bad, firm i's equilibrium output is $q_i^b = (\theta y - c)/[(1 + \eta)\theta]$, and its equilibrium profit is:

$$\pi_i^{b*} = \frac{(\theta y-c)^2}{(1+\eta)^2\theta} - f_i \tag{50}$$

We focus on the case in which only the highest-cost firm, firm 1, will be unprofitable and then only in the bad market, i.e., $\pi_1^{b*} < 0$. Thus, firm 1 will have to exit the market in this situation. We also assume that a merger of two rival firms will be approved by the regulator only if it involves firm 1 and then only when the market is bad.

Can firm 1 use debt financing strategically to motivate a merger with a healthy rival in the oligopoly market when the market is bad? It is evident that the equilibrium conditions for such a merger to take place are analogous to Conditions (A) through (F) in the duopoly case. The only difference is in the post-merger profit of the remaining firms, say firm $j \in \{2,3,...,\eta\}$, in the oligopoly of $\eta - 1$ firms. If the market is bad, firm j's profit is:

$$\Pi_{j,\eta-1}^b = \frac{(\theta y-c)^2}{\eta^2\theta} - f_j \tag{51}$$

We omit the results in the oligopoly market that would be analogous to those in the duopoly. However, in the oligopoly, the difference between remaining firm j's profit $\Pi_{j,\eta-1}^b$ if the merger takes place, and $\Pi_{j,\eta}^b$ if it does not, is decreasing in the number η of firms. Therefore, the smaller the number of firms in the oligopoly (i.e., the more concentrated the industry), the more likely it is that the high-cost firm will succeed in its strategy of motivating a buyout by a rival. With a larger number of industry rivals, the benefit received by the acquiring firm is reduced, because more firms share in a smaller increase in the industry's profits from shutting down firm 1.

One interesting question is which one of the healthy firms is more likely to acquire firm 1 if the firms differ in their production costs. To address this question, we let firm $k \in \{2,3,...,\eta\}$ be the acquirer of firm 1 and firm j be a non-acquirer, $j \neq k$. If the market is bad, the acquirer's

expected post-merger payoff is:

$$\tilde{\pi}_k^b = \Pi_{k,\eta-1}^b + B_1 - \alpha(s_{11} + b_{11}) - (1-\alpha)(s_{k1} + b_{k1}) \tag{52}$$

where $s_{l1} + b_{l1}$ is the buyout price for firm 1's assets if firm $l \in \{1,k\}$ makes the merger proposal. In contrast, the non-acquiring firm j's profit is:

$$\tilde{\pi}_j^b = \Pi_{j,\eta-1}^b = \frac{(\theta y - c)^2}{\eta^2 \theta} - f_j \tag{53}$$

Then firm k has the greater incentive to acquire firm 1 if its expected profit after this acquisition is greater than that of firm j. We note that:

$$\tilde{\pi}_k^b - \tilde{\pi}_j^b < \Pi_{k,\eta-1}^b + B_1 - s_{k1} - b_{k1} - \Pi_{j,\eta-1}^b < f_j - f_k \tag{54}$$

In the above, the first inequality follows from $s_{11} + b_{11} > s_{k1} + b_{k1}$ because firm 1's proposed buyout price for its own assets must be greater than that proposed by firm 2. The last inequality follows because $B_1 < s_{k1} + b_{k1}$, as in the results in Proposition 3. Therefore, a particular firm has the greatest incentive to acquire firm 1 only if its production costs are sufficiently lower than the other firms' costs. Having relatively lower production costs enables the acquiring firm to obtain a greater portion (relative to its rivals) of the post-merger industry profits.

If the various healthy firms' production costs are sufficiently close to each other, so that Condition (54) is not satisfied, then the acquirer's expected profit from making the merger offer would be lower than that of a non-participating passive firm. In this case, each firm is better off if one of the others makes the buyout offer, but if none buys out firm 1, all expect to be worse off. While it is unclear how this problem may be resolved, its mere existence reduces the likelihood of a buyout of firm 1 by a rival.

IV. Conclusion and Empirical Implications

Our article shows how a strategically chosen capital structure may enable a high-cost firm that is facing exit from its product market to achieve a merger with a healthy rival. By committing itself to continue unprofitable operations, thereby reducing industry profits, the high-cost firm makes its takeover by an industry rival an attractive alternative. The firm's use of sufficient debt financing ensures that the decision to maintain production is optimal for its shareholders and therefore that the threat to produce is credible. We focus on a duopoly example, but we also show that this strategy is applicable to an oligopoly market, although the conditions for its success are more stringent because of the potential free-rider problem. Although all profitable firms in such an oligopoly want the unprofitable rival to shut down, each prefers that one of its competitors undertakes the buyout. Our analysis can be viewed as especially relevant for firms under Chapter 11 bankruptcy protection that allows them to issue new debt to continue their operations, thereby motivating their buyout by a rival.

In our analysis, the role of debt in takeovers differs from that in the literature. Increasing

leverage has been described as a defensive measure by a potential target. In our paper, a firm's use of debt serves to promote its takeover. However, these two predictions are not mutually exclusive, but complementary. In our analysis, rather than resisting a takeover, a firm seeks to be acquired and uses a levered capital structure to motivate the desired merger by making continued operations optimal for its shareholders. Our analysis is yet another example that illustrates a potential benefit of debt financing, namely, that debt may help a firm extract a better buyout price from a rival even when the firm is unprofitable. This feature of debt has already been studied in the literature, but our analysis explores a different aspect of the relation between a target firm's capital structure and the likelihood of a merger, and we demonstrate that the two can be positively related.

Our analysis has empirical implications for takeovers of distressed firms in imperfectly competitive markets. Some of the implications are consistent with available evidence. Others could motivate further empirical studies. Below, we summarize the empirical implications of our model. First, our model predicts a positive stock price reaction to the announcement of a debt issue by a distressed firm. The debt issue increases the likelihood that the firm will be acquired by a healthy rival. Second, concerning the likelihood of a distressed firm successfully adopting the strategy of motivating its acquisition by a healthy rival, we have the following:

- All else equal, distressed targets are more likely to pursue the exit-by-merger strategy if the regulatory antitrust environment is less stringent and, in particular, if the regulator is more likely to allow exceptions under the "failing-firm" defense.
- Within the "failing-firm" exception to industry mergers, the likelihood of a distressed firm adopting the exit-by-merger strategy is increasing in the concentration within the industry.
- The distressed firm's exit-by-merger strategy is more likely to be successful if the production costs of its healthy rivals are sufficiently different.

Our model's predictions can be compared with recent evidence in Clark and Ofek (1994). Examining the nature and characteristics of bidders and targets in takeovers of distressed firms, Clark and Ofek report the following observations:

- Distressed targets are more likely to be acquired by firms in the same industry, compared to acquisitions in general.
- Such takeovers are more likely to be friendly, i.e., not resisted by the target, compared to acquisitions in general.
- The distressed targets have been performing poorly prior to the acquisition relative to other firms in the industry.
- The distressed targets are significantly more levered than other firms in the industry as well as relative to the acquirer.
- Most (more than three fourths) target firms have only one bidder.
- The targets that are operationally, rather than financially, distressed are more likely to be unsuccessfully restructured in the post-merger period.

All of the above observations are consistent with the empirical implications of our model. The target firm and acquirer in our analysis would obviously be in the same industry and the target would not only not oppose the acquisition, it would seek to motivate it. Furthermore, the target firm in our model is not only unprofitable compared to its rivals, it is also sufficiently unprofitable to result in eventual exit from the industry. When we examine the leverage of the

target, although our model describes the firm as raising its leverage (above industry norms) to motivate its acquisition, doing so is clearly unnecessary. All our analysis requires is that the poorly performing target firm has sufficiently high leverage, relative to its industry rivals, to make the continuation of unprofitable production optimal for the firm's equityholders if there is no buyout. As mentioned earlier, this feature of our analysis relating the use of debt as a means of promoting a takeover contrasts with the predictions in the literature describing it as a deterrent. The observation of Clark and Ofek (1994) that the distressed targets are relatively more levered than their industry rivals is consistent with our analysis. In addition, Ghosh, Owers, and Rogers (1991) report that voluntarily liquidated firms tend to be poor performers, but have low leverage. This observation is also consistent with our model that predicts that among the set of poorly performing firms, leverage is lower for those that are not able to use their capital structure to motivate their buyout and thus must liquidate their assets. The finding that target firms generally have only one bidder is also consistent with our model. However, our analysis goes further and predicts that such bidders should be the most profitable firms in their industries. Finally, our exiting firm is operationally, rather than financially, distressed in that it is the high-cost producer in its industry and its production is unprofitable at any leverage ratio (when market demand is low). Restructuring of this firm is unlikely to be successful and is not the motivation for the acquisition. Removing the firm from the industry is the acquirer's goal.■

Appendix

Proof of Proposition 1: Condition (15) is a combination of Conditions (13) and (14). To show that the set of D_1 characterized by Condition (15) is not empty, we note that the difference between this condition's upper and lower bounds is $5(\theta y - c)^2/(36\theta) > 0$. Now, if Condition (15) is satisfied, firm 1 will continue production in the bad market if there is no merger. Knowing this threat, firm 2 will want to acquire firm 1 and subsequently shut it down. Q.E.D.

Proof of Proposition 2: To show $\hat{\pi}_1^{b*} > \hat{\pi}_1^{g*} \geq 0$, we first note that from the lower bound of D_1 in Condition (23),

$$\hat{\pi}_1^{b*} - \hat{\pi}_1^{g*} = \frac{(\theta y - c)^2}{9\theta} - \frac{(y-c)^2}{9} + (1-\theta)D_1$$
$$> \frac{(\theta y - c)^2}{9\theta} - \frac{(y-c)^2}{9} + \left[\frac{(y-c)^2}{9} - \frac{(\theta y - c)^2}{9\theta}\right] = 0. \quad \text{(A1)}$$

Given $B_1 = (1+\theta)D_1/2$, we also note that from the upper bound of D_1 in Condition (23),

$$\hat{\pi}_1^{g*} = \frac{(y-c)^2}{9} - f_1 - \frac{1-\theta}{2}D_1 \geq \frac{(y-c)^2}{9} - f_1 - \left[\frac{(y-c)^2}{9} - f_1\right] = 0 \quad \text{(A2)}$$

To show that D_1 characterized in Condition (23) is not empty, we consider:

$$2\left[\frac{(y-c)^2}{9}-f_1\right]-\left[\frac{(y-c)^2}{9}-\frac{(\theta y-c)^2}{9\theta}\right]=\frac{(y-c)^2}{9}+\frac{(\theta y-c)^2}{9\theta}-2f_1$$
$$>\frac{(y-c)^2}{9}+\frac{(\theta y-c)^2}{9\theta}-\left[\frac{(y-c)^2}{9}+\frac{(\theta y-c)^2}{9\theta}\right]=0 \quad \text{(A3)}$$

The last inequality above follows from the upper bound on f_1, given in Condition (22). The set of f_1 characterized by the same condition is also not empty, because:

$$\frac{(\theta y-c)^2}{9\theta}<\frac{(y-c)^2}{18}+\frac{(\theta y-c)^2}{18\theta}<\frac{(y-c)^2}{9} \quad \text{(A4)}$$

We now show that given $\hat{\pi}_1^{b*} > \hat{\pi}_1^{g*} \geq 0$, if there is no merger, firm 1 shareholders' decision to compete in the bad market is renegotiation-proof. We recall that in the absence of such a merger, firm 1's debtholders are uninformed about the bad market. Thus, the lenders must induce the firm's shareholders to stop production when the market is bad. If firm 1's lenders offer its shareholders a payoff of $\pi_1^{(d)} < \hat{\pi}_1^{g*}$, the shareholders will reject this offer because their payoff from production under both market conditions is greater. Thus, we focus on the offer with $\pi_1^{(d)} < \hat{\pi}_1^{g*}$. We first consider $\pi_1^{(d)} \in [\hat{\pi}_1^{g*}, \hat{\pi}_1^{b*})$. Such an offer will only cause firm 1's shareholders to stop production when the market is good, but not when the market is bad. If production is stopped in the good market, firm 1's lenders will receive $B_1 - \pi_1^{(d)} < D_1$. But D_1 is what the lenders will get from production. Thus, firm 1's debtholders will not want to make this offer. If the lenders instead offer $\pi_1^{(d)} \geq \hat{\pi}_1^{b*}$, firm 1's shareholders will stop production under both market conditions. In this case, the lenders' payoff will be $B_1 - \pi_1^{(d)} < B_1 = (1+\theta)D_1/2$. That is, it is also less than the lenders' expected payoff from production. Therefore, firm 1 shareholders' decision to continue production if there is no merger is renegotiation-proof. *Q.E.D.*

Proof of Proposition 3: We first show that the equilibrium Conditions (A) and (B) are satisfied. By substituting Π^b, $B_1 = (1+\theta)D_1/2$, $b_{11} = \theta D_1$, $\hat{\pi}_1^{b*}$, and $\hat{\pi}_2^{b*}$, we have:

$$s_{11} - \hat{\pi}_1^{b*} = \Pi^b + B_1 - \theta D_1 - \hat{\pi}_2^{b*} - \hat{\pi}_1^{b*} = \frac{(\theta y-c)^2}{36\theta} + f_1 + f_2 > 0 \quad \text{(A5)}$$

Hence, $s_{11} > \hat{\pi}_1^{b*} > 0$. For the alternative, we have $s_{21} = \hat{\pi}_1^{b*} > 0$. Thus, firm 1's shareholders are no worse off with the merger. Likewise, to show that firm 2 is also no worse off with the merger, we note that:

$$\Pi^b + B_1 - s_{11} - b_{11} - \hat{\pi}_2^{b*} = 0 \quad \text{(A6)}$$
$$\Pi^b + B_1 - s_{21} - b_{21} - \hat{\pi}_2^{b*} = \frac{(\theta y-c)^2}{36\theta} + f_1 + f_2 > 0 \quad \text{(A7)}$$

We now verify that Conditions (C), (D), and (E) are satisfied. From Proposition 2, Condition (D) is guaranteed by Condition (22) and by the equilibrium D_1 satisfying Condition (23).

Thus, if there is no merger, firm 1's shareholders choose production to exit, and this production decision is renegotiation-proof. Since the two firms will merge when the market is bad, but not when the market is good, firm 1 lenders' beliefs, given in Condition (C), are rational. Condition (E) is satisfied because the buyout price for firm 1's debt, $b_{11} = b_{21} = \theta D_1$, is minimally acceptable to the lenders, given their beliefs that the market is bad conditioned on the merger agreement.

To show that Condition (F) is satisfied, we consider firm 1 shareholders' objective function (30):

$$\begin{aligned}&\hat{\pi}_1^{g*} + \alpha s_{11} + (1-\alpha)s_{21} \\ &= \frac{(y-c)^2}{9} + \frac{(\theta y - c)^2}{9\theta} - 2f_1 + \alpha\left[\frac{(\theta y - c)^2}{36\theta} + f_1 + f_2\right] > 0.\end{aligned} \tag{A8}$$

The last inequality above follows from the upper bound in Condition (22). Since the objective function does not depend on the exact D_1 chosen, as long as it satisfies Condition (23), an optimal D_1 is that given by the upper bound in Condition (23). To show that the optimal payoff to firm 1's shareholders with the debt is greater than that without it, we consider:

$$\begin{aligned}&\hat{\pi}_1^{g*} + \alpha s_{11} + (1-\alpha)s_{21} - \pi_1^{g**} \\ &= -\frac{5(y-c)^2}{36} + \frac{(\theta y - c)^2}{9\theta} - f_1 + \alpha\left[\frac{(\theta y - c)^2}{36\theta} + f_1 + f_2\right]\end{aligned} \tag{A9}$$

The above expression is positive, i.e., the debt use is preferred, for all α satisfying:

$$\alpha > \alpha^* \equiv \left[\frac{5(y-c)^2}{36} - \frac{(\theta y - c)^2}{9\theta} + f_1\right] \Big/ \left[\frac{(\theta y - c)^2}{36\theta} + f_1 + f_2\right] > 0 \tag{A10}$$

To ensure $\alpha^* < 1$, the above numerator must be less than the denominator, i.e.,

$$f_2 > f_2^* \equiv \frac{5(y-c)^2}{36} - \frac{5(\theta y - c)^2}{36\theta} \tag{A11}$$

Since Condition (7) requires $f_2 < (\theta y - c)^2/(9\theta)$, we also need:

$$\frac{5(y-c)^2}{36} - \frac{5(\theta y - c)^2}{36\theta} < \frac{(\theta y - c)^2}{9\theta} \tag{A12}$$

We define a critical value of θ, θ^*, that makes the above condition an equality, i.e.:

$$\frac{(\theta^* y - c)^2}{\theta^*} = \frac{5(y-c)^2}{9} \tag{A13}$$

We see $\theta^* \in (c/y,1)$, and that for all $\theta > \theta^*$, the set of f_2 satisfying $f_2^* < f_2 < (\theta y - c)^2/(9\theta)$ is not empty. Therefore, for all $\theta > \theta^*$ and f_2 that satisfies this condition, we have $\alpha^* \in (0,1)$, and for all $\alpha > \alpha^*$, Condition (31) is satisfied. Finally, we see that Condition (32) is satisfied, and so is Condition (F). *Q.E.D.*

Proof of Proposition 4: We need only show that $\theta^{**} > \theta^*$. We recall that θ^{**} is the critical value of θ that makes Condition (46) an equality, i.e.:

$$\frac{(\theta^{**} y - c)^2}{\theta^{**}} = \frac{5(y-c)^2}{8} \tag{A14}$$

Clearly, $\theta^{**} > c/y$, and since $5(y-c)^2/8 > 5(y-c)^2/9$, we have $\theta^{**} > \theta^*$. *Q.E.D.*

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