Duopoly Investment Behavior in the Presence of Chapter 11 Reorganization

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Abstract

How does the prospect of Chapter 11 reorganization influence the capital investment decisions of oligopolistic firms? Economists agree that bankruptcy policy matters for *ex ante* investment, yet most models either ignore the strategic implications of this effect, or oversimplify bankruptcy by equating it with liquidation. Because Chapter 11 permits abrogation of long-term contracts (e.g. for labor or capital), it provides an otherwise constrained firm the opportunity to right-size and re-emerge, giving bankruptcy law an influence on firms' *ex ante* investment behavior, with direct implications for their interactions with rivals. This paper analyzes the link between capital investment and reorganization using a straightforward dynamic duopoly game that highlights the role of investment (ir)reversibility. I show that an increase in the costs associated with Chapter 11 will tend to discipline *ex ante* behavior in equilibrium, curbing investment in periods of high demand and spurring the sale of capital when demand is low.

JEL Codes: D21, D25, G28, G33, K00, L13

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I. Introduction

Since Arrow (1968), the field of industrial organization (I.O.) has acknowledged that investment irreversibility (or "sunkness") is a key determinant of the firm's investment decision. Moreover, as so many textbooks in game theory, strategy, and industrial organization have illustrated, the strategic potency of an invesment hinges upon the degree to which it represents an irreversible commitment. This idea is much older than its formalization in the context of economic models, of course. For example, the age-old notion of "burning the boats" loses its significance if the boats can be miraculously restored! Yet precisely this sort of reversal of otherwise irreversible decisions is often found during Chapter 11 bankruptcy cases in the United States. Long-run contracts, such as collective bargaining agreements, pension benefit arrangements, leases, and the like produce a strong level of commitment by effectively creating a cost to downsize, yet bankruptcy court judges have the power to modify or rescind such contracts when it is in the interest of the bankrupt entity's estate. Given that reorganization under Chapter 11 of the U.S. Bankruptcy Code is a common setting for rescinding and/or renegotiating such contracts, one would expect bankruptcy policy to play a significant role in oligopoly investment models. Yet studies of capital investment in such models typically ignore bankruptcy entirely.[1] Those I.O. papers that do allow for bankruptcy typically view it as a final outcome, tantamount to exit. While liquidation under Chapter 7 of the U.S. Bankruptcy Code can certainly be likened to exit, as it is in seminal works such as Brander and Lewis (1988) and Cooley and Quadrini (2001)[2], the vast majority of large corporate bankruptcy cases in the United States are filed under Chapter 11.[3] Unlike liquidation proceedings, Chapter 11 cases are brought forth with the goal of exiting from

[1]A partial reading list might include such papers as Bertola and Caballero (1994), Ericson and Pakes (1995), Abel and Eberly (1996), Besanko and Doraszelski (2004), Bloom et al. (2007), and Besanko et al. (2010).

[2]Cooley and Quadrini (2001) notably mention bankruptcy in their analysis of the influence of financial market frictions on firm dynamics. In that model, default leads to renegotiation of debt, with the outside option being liquidation and exit, which never occurs in equilibrium

[3]Author's calculations based on LoPucki (2017). Among publicly traded U.S. firms that filed under Chapter 11 between 1980 and 2017 and had at least $100 million in assets (in 1980 dollars), 97.8% filed under Chapter 11.

bankruptcy court protection, not exiting from the market. Neither is this goal unreasonable: more than two thirds of large public firms filing under Chapter 11 eventually do emerge from bankruptcy.[4] It seems natural, then, to ask how such a policy affects the equilibrium investment behavior of oligopolistic firms.

To answer that question, I develop a straightforward dynamic duopoly investment model that illustrates the link between Chapter 11 reorganization and capital investment by focusing attention on the irreversibility of investment. In my model, which has its foundation in Aghion et al. (2001) and Acemoglu and Akcigit (2012), firms add capital during high-demand states and disinvest capital during low-demand states. Bankruptcy results in downsizing via reorganization, the cost of which encompasses legal and administrative costs, expected repayments to creditors, liquidation risk, and any other economic costs to the firm, such as reputational damage. I show that, in equilibrium, higher reorganization costs reduce a firm's incentive to invest during periods of high demand and increase its likelihood of disinvestment during periods of low demand. In other words, a policy change that makes Chapter 11 more creditor-friendly, and therefore more costly from the firm's perspective, will tend to rein in, or discipline, capital investment behavior overall.

This new result arises from treating bankruptcy not as exit, but as a costly means of downsizing, and reveals a previously unexplored effect of bankruptcy policy on investment that is both significant and intuitive, yet distinct from typical corporate finance considerations. In order to isolate this effect, I have abstracted away from the capital structure decision entirely. While this undoubtedly limits the model, it also serves to clarify the effect I aim to illustrate, namely, the non-financial relationship between Chapter 11 reorganization and capital investment induced by the treatment of contracts in and out of bankruptcy court.

Bankruptcy, however, is an inherently financial tool, afforded only to insolvent firms. Since a firm must have debt to be insolvent, bankruptcy policy is intrinsically tied to capital struc-

[4] Author's calculations based on LoPucki (2017). Among publicly traded U.S. firms that filed under Chapter 11 between 1980 and 2017 and had at least $100 million in assets (in 1980 dollars), 67.5% emerged from bankruptcy.

ture, a well-studied concept in the corporate finance literature. Thus it makes sense that the I.O. literature might tend to ignore the nuances of bankruptcy policy, and we might expect instead to see this effect mentioned in the corporate finance literature. Yet because corporate finance has historically devoted its attention to individual firms' decisions, espeically those pertaining to its capital structure, that literature's excellent grasp of bankruptcy tends to abstract away from strategic interaction, at least with respect to other firms. The field of law and economics appears to have analyzed the nuances of bankruptcy policy more than any other, yet again the tendency has been to focus on individual firm decisions, to the exclusion of strategic interaction with other firms outside of financial distress. In both literatures, it is abundantly clear that bankruptcy law matters for *ex ante* investment, yet the mechanism of action is almost always financial. The remainder of this paper proceeds as follows: Section II reviews the relevant literature. Section III presents the model, and Section IV analyzes the equilibrium and comparative statics associated with changes in bankruptcy law.

II. Literature Review

A number of studies have combined insights from corporate finance, law and economics, and industrial organization, yet none has shown how reorganization under Chapter 11 (as opposed to liquidation under Chapter 7) can influence capital investment in an imperfectly competitive environment. In this section I summarize the relevant components of these three strands of literature, highlighting this important gap.

Beginning with Arrow (1968) and Spence (1979), industrial economists have recognized the important role of investment (ir)reversibility for firm behavior. Pindyck (1988) demonstrates that irreversibility of investment reduces optimal capacity relative to an environment where investment decisions are reversible. This seminal paper identified the real option value associated with delaying such an investment when demand is uncertain. Jou and Lee (2008) extend earlier analyses in the real options literature to an oligopolistic industry. Their model incorporates choices over capital structure, investment scale and timing, and bankruptcy filing. By treating investments as fixed and bankruptcy as final, however, the authors necessarily abstract away from both the evolution of capital in the industry and the transient nature of Chapter 11 protection.

A rather extensive literature pertains to strategic capacity decisions, and capacity buildup is often described as an effective means of deterring entry. Eaton and Lipsey (1979) show that anticipated growth leads to buildup of capacity by incumbents that, when compared to the decisions of potential entrants, appears premature. Besanko et al. (2010) examines a dynamic model of discrete ("lumpy") capacity investment, finding that greater product homogeneity and capacity reversibility promote capacity preemption races. The authors also link excess capacity in the short run to capacity coordination in the long run, and show that capacity preemption races become more intense the more reversible is capital investment. This conclusion runs counter to the typical intuition that investment reversibility implies weaker commitment, such that the benefits of capacity leadership are transient. On the contrary, reversible investment encourages entry into the race to begin with by reducing the cost of committing to the race long-term. My results tell a similar story. That is, when reorganization becomes more costly, investment becomes less reversible, and capacity build-up during good states of the world declines. Relative to this strand of literature, then, the key contribution of my paper is to demonstrate how this sort of behavior can arise from a change in insolvency policy, which is not traditionally associated with models of capacity build-up in I.O.

Any episode of insolvency presupposes the presence of debt, so before describing the impact of bankruptcy law on firms' investment decisions, we must acknowledge the more general role of capital structure on those decisions. Since at least the 1980s, economists have recognized that capital structure may influence product market competition. Viewing bankruptcy as default-induced exit (i.e. liquidation), Brander and Lewis (1986, 1988) describe two effects. The "limited liability effect" captures the incentive a firm will have to pursue riskier product market strategies because equity holders do not share in downside risk below the point of bankruptcy. The "strategic bankruptcy effect" captures the incentive for a firm to pursue product market strategies that will increase the likelihood of competitor bankruptcy, which is contingent upon competitors' financial structures. To isolate the linkages between financial markets and product markets, Brander and Lewis (1986) treat capital investment as fixed, allowing firms to choose their debt/equity ratios in the first stage of a two-stage duopoly model.[5] The limited liability effect they describe is therefore solely due to short-run competition in output effected through changes in variable inputs. Linking capital structure to input decisions is Matsa (2010), which demonstrates how the presence of collective bargaining agreements can impact the choice of debt levels. Abstracting away from the capital investment decision allows the aforementioned authors to focus on capital structure decisions and to avoid the additional effects of commitment, studied by Dixit (1980), Eaton and Lipsey (1980), Brander and Spencer (1983), and others. Whereas Brander and Lewis (1986) and Matsa (2010) linked the capital structure decision with output market strategies, holding investment levels fixed, I will ignore the capital structure decision to identify how changes in bankruptcy law can influence capital investment decisions that are otherwise irreversible. The interested reader in corporate finance should review the citations within Brander and Lewis (1986, 1988) for foundational articles on capital structure choice, and in particular, for exceptions to the Modigliani and Miller (1958) theorems.[6]

The corporate finance literature has adopted endogenous liquidation as the standard model, beginning with Leland (1994) and Leland and Toft (1996), but recent work has begun to incorporate the reorganization option.[7] Despite these advances, corporate finance models of

[5]One might wonder why we do not simply extend this model to allow for another stage in which firms choose capital investment, either before or after choosing capital structure. First, in the Brander and Lewis (1986, 1988) models, bankruptcy is viewed as liquidation/exit, and my primary purpose in this paper is to analyze the most salient alternative, reorganization. Second, while understanding the full strategic interplay among investment, capital structure, insolvency policy, and product market competition is undoubtedly crucial for our understanding of industrial organization, I view this paper, which isolates the effect of insolvency policy on investment behavior, as a necessary first step.

[6]A good reading list would certainly begin with Jensen and Meckling (1976), Myers (1977), and Bulow and Shoven (1978).

[7]See, for example, the excellent work of Sundaresan and Wang (2007), Broadie et al. (2007), Li et

capital investment and/or capital structure understandably focus on the financing choices of firms, primarily in single-agent settings. Suo, Wang, and Zhang (2013) and references therein provide a few examples. Broadie, Chernov, and Sundaresan (2007) extend these models of optimal capital structure by allowing for reorganization under Chapter 11 in addition to liquidation under Chapter 7. Hamoto and Correia (2012) provide a nice overview of the different models of default, liquidation, and bankruptcy, identifying Broadie et al. (2007) as the only paper to incorporate Chapter 11, although several authors separate the default and liquidation decisions. More recently, two fantastic papers by Antill and Grenadier (2019) and Corbae and D'Erasmo (2017) both incorporate the liquidation vs. reorganization choice. Antill and Grenadier (2019) develop a model of optimal capital structure that includes dynamic bargaining between creditors and equityholders. Corbae and D'Erasmo (2017) estimate a general equilibrium model of firm dynamics with endogenous entry and exit of competitive firms in order to examine the effects upon firm dynamics of a proposed bankruptcy reform. Both of these papers push the frontier forward a great deal, yet both remain focused on the financing decisions of firms and the financial provisions of bankruptcy law. Thus, any discussion of the reversibility of capital investment, and its strategic implications, remains untethered to this strand of the literature.

The law and economics literature on bankruptcy policy is imposing. Its coverage of insolvency policy in general, and Chapter 11 reorganization in particular, is detailed and wide-ranging. While this strand of the literature takes quite seriously the strategic interactions amongs debtors, creditors, and other stakeholders, especially during bankruptcy proceedings, strategic interaction amongst non-bankrupt firms appears absent.[8] Instead, the analysis typically centers on the firm and its stakeholders in order to evaluate the efficiency and efficacy of bankruptcy policy, especially the effects of bankruptcy law's provisions on the bargaining

al. (2014), Shibata and Nishihara (2015), Corbae and D'Erasmo (2017), Antill and Grenadier (2019), and references therein.

[8] I am happy to be wrong here, so I encourage the reader to let me know directly of any works I may have overlooked. The literature is vast, but I have done my best to review it.

process before and during bankruptcy[9]; the investment decision during times of financial distress[10]; and the efficiency with which the current bankruptcy regime liquidates unviable entities and resucitates viable ones.[11] Clearly there is a great deal of overlap here with corporate finance, as incentives (or disincentives) for investing and borrowing induced by bankruptcy law have implications for firm value and financial performance. For excellent overviews of the economic thinking surrounding bankruptcy, see Jackson (1986), White (1989), and White (2007). With respect to investment in particular, the effect of bankruptcy law generally hinges on the agency conflict between owners and managers in choosing the optimal riskiness of projects undertaken. That effect is, in turn, mediated by the treatment of the firm in bankruptcy (i.e. priority rules, deviations from them, provisions governing the bargaining process, etc.).[12] Bebchuk (2002) provides thorough coverage of this issue in presenting an analysis of the *ex ante* costs of deviating from the absolute priority rule in bankruptcy. Rasmussen (1994) examines the *ex ante* investment effects of then-current bankruptcy law as well as various proposed reforms. He notes well that that bankruptcy changes more than just capital and ownership structure. In many cases, it leads to changes in leadership and operations as well, and the prospect of these changes has important implications for *ex ante* behavior. In this paper, I focus on the changes in interfirm contracts brought about by Chapter 11, and I demonstrate that they do indeed matter for *ex ante* investment decisions in the context of imperfect competition. Whether we are concerned with the efficiency of bankruptcy policy, its effects on borrowing and capital structure, or its potential to alter the product market behavior of firms, understanding how it influences *ex ante* investment in this context is an important dimension of the discussion. With that in mind, I now lay out the fundamentals of my model.

[9]See, for example, Bebchuk and Chang (1992).

[10]See, for example, Gertner and Scharfstein (1991), Schwartz (1994), and Adler (1995).

[11]See, for example, White (1994) and Eraslan (2008).

[12]An important exception in that regard is Rose-Ackerman (1991) and related works that consider the behavioral implications of a manager's personal aversion to bankruptcy on account of overinvestment in the company itself.

III. Model

In this section I analyze a dynamic, continuous-time duopoly model of investment and reorganization to show how equilibrium investment behavior changes with Chapter 11 reorganization costs. This simple model, inspired by Acemoglu and Akcigit (2012) and founded upon Aghion et al. (2001), reveals two key insights. First, an exogenous change that makes Chapter 11 reorganization more costly will limit capital expansion when demand is high. Second, the same exogenous change will quicken capital retraction when demand is low. In other words, as Chapter 11 reorganization becomes more costly, firms will be less willing to invest when demand is good and more willing to get rid of capacity when demand is bad.

III.A. Investment and Disinvestment

Suppose two firms compete in continuous time, and their instantaneous profits are functions only of their size relative to one another. Under normal industry conditions, which we will label as high demand, larger relative size results in higher profit, creating an incentive to accumulate capital in the same way that firms in Aghion et al.'s (2001) and Acemoglu and Akcigit (2012) model's have an incentive to invest in R&D. To examine the role of bankruptcy, let us also consider what happens when industry demand falls precipitously. Suppose that the industry's demand state can be either high or low, and it evolves randomly according to two Poisson arrival processes. When demand is high, nature arrives at rate ψ to reverse the demand state. When demand is low, nature arrives at rate ψ' to reverse the demand state. An important feature of the low demand state is that profit is strictly decreasing in relative size, creating an incentive to disinvest capital. Thus, firm i's profit, conditional upon demand, can be given in reduced form by a function of i's capital level relative to its competitor. Following Acemoglu and Akcigit's (2012) partial equilibrium illustration, let us suppose this relative level, n_i, takes on one of 5 values, such that $n_i \in N \equiv \{-2, -1, 0, 1, 2\}$.

Flow profit is given by

$$\Pi(n_i) \in \{\pi_{-2}, \pi_{-1}, \pi_0, \pi_1, \pi_2\} \ , \ \pi_{n+1} > \pi_n \text{ when demand is high, and}$$
$$\Pi'(n_i) \in \{\pi'_{-2}, \pi'_{-1}, \pi'_0, \pi'_1, \pi'_2\} \ , \ \pi'_n > \pi'_{n+1} \text{ when demand is low.}$$

In summary, having more capital relative to your opponent is profitable in high-demand states, but costly in low-demand states.[13] Given this ordering, firms will want to increase their capital stock under normal industry conditions, and decrease it in times of distress, all else equal.

Firms act to change their capital levels via investment during high-demand states and disinvestment during low-demand states. When demand is high, each firm can increase its capital level by a Poisson investment process, which yields a unit increase to the capital stock at rate $x_i \geq 0$ and costs λx_i. In the same way, when demand is low, each firm can decrease its capital level at rate $y_i \geq 0$ at a cost of θy_i. The cost of disinvestment, θ, can be viewed as a measure of the irreversibility of investment, in that higher values of θ imply greater barriers to downsizing.

III.B. Reorganization

In each demand state, for each relative capital level, the arrival rate of reorganization follows two Poisson processes, one yielding a single increment decrease in capital, and another resulting in a two-increment decrease. In other words, firms are occasionally forced to downsize by either one or two units. Note that bankruptcy-induced exit (i.e. liquidation) is not

[13] The fact that profit is increasing in size can be justified if size is related to quality, as in many network industries. Consider the airline industry, for instance. For an airline, large fleet size may mean more flights per day at more convenient times for travelers, more destinations served per airport, more convenient connections, more opportunities for the redemption of flight miles, bigger and better planes, or even less crowded planes. Yet large size could be costly in downturns if, for example, fixed costs are linear in capacity, while variable profits are concave. If the demand state shifts variable profit only, then fixed costs may very well dominate when demand is low. The airline industry offers a useful case study in this situation as well. If contractual commitments keep airlines flying planes even when weak demand would otherwise cause them to reduce capacity, then large fleet size could very well represent a major liability in such states of the world.

parameterized below, but the model could be extended to account for it. The overall rate of reorganization is held constant for a given demand and capital state, such that

$$D_{N_I} \equiv \begin{cases} d_2 & = \gamma_2 d_2 + (1-\gamma_2) d_2 \\ d_1 & = \gamma_1 d_1 + (1-\gamma_1) d_1 \\ d_0 & = \gamma_0 d_0 + (1-\gamma_0) d_0 \\ d_{-1} & = d_{-1} \\ d_{-2} & = 0 \end{cases} \text{ when demand is high, and}$$

$$B_{N_I} \equiv \begin{cases} b_2 & = \phi_2 b_2 + (1-\phi_2) b_2 \\ b_1 & = \phi_1 b_1 + (1-\phi_1) b_1 \\ b_0 & = \phi_0 b_0 + (1-\phi_0) b_0 \\ b_{-1} & = b_{-1} \\ b_{-2} & = 0 \end{cases} \text{ when demand is low,}$$

where γ_n represents the probability that reorganization will be of the two-increment type when demand is high, and ϕ_n represents the probability that reorganization will be of the two-increment type when demand is low.

Upon default, firms must pay a lump-sum, capital-dependent fee reflecting the total cost of Chapter 11 reorganization. As mentioned above, this cost is inclusive of legal and transactional fees, payouts to various stakeholders, etc.[14] These reorganization costs, $R(n_i) \in \{R_{-1}, R_0, R_1, R_2\}$ are independent of both the demand state and the size of default, and they are not paid when firms transition to lower states of their own accord.

[14] It is worth noting that liquidation could be implicitly embedded here in the context of a single-agent model. For example, if default entails some probability of liquidation, which is equivalent to exit and has a continuation value normalized to zero, then the lump-sum cost of reorganization could simply be redefined to include the expected (negative) value of that event. However, in a duopoly context we must account for what happens after a firm exits. It will be this prospect of monopoly profit that returns the strategic bankruptcy effect of Brander and Lewis (1986, 1988).

IV. Analysis and Conclusions

IV.A. Value Functions and Equilibrium

Given the above setup, firms maximize the present value of future profits according to a common rate of time preference $r > 0$. Let V represent value functions in high demand states and W represent value functions in low demand states. We can then define firm values recursively as follows

$$rV_2 = \pi_2 + x_{-2}[V_1 - V_2] + (1-\gamma_2)d_2[V_1 - V_2 - R_2] + \gamma_2 d_2[V_0 - V_2 - R_2] + \psi[W_2 - V_2] \quad (1)$$

$$rV_1 = \max_{x_1 \geq 0} \begin{cases} \pi_1 - \lambda x_1 + [x_1 + d_{-1}][V_2 - V_1] + x_{-1}[V_0 - V_1] + ... \\ +(1-\gamma_1)d_1[V_0 - V_1 - R_1] + \gamma_1 d_1[V_{-1} - V_1 - R_1] + \psi[W_1 - V_1] \end{cases} \quad (2)$$

$$rV_0 = \max_{x_0 \geq 0} \begin{cases} \pi_0 - \lambda x_0 + [x_0 + (1-\gamma_0)d_0][V_1 - V_0] + x_0'[V_{-1} - V_0] + ... \\ +(1-\gamma_0)d_0[V_{-1} - V_0 - R_0] + \gamma_0 d_0[(V_2 - V_0) + (V_{-2} - V_0 - R_0)] + \psi[W_0 - V_0] \end{cases} \quad (3)$$

$$rV_{-1} = \max_{x_{-1} \geq 0} \begin{cases} \pi_{-1} - \lambda x_{-1} + [x_{-1} + (1-\gamma_1)d_1][V_0 - V_{-1}] + x_1[V_{-2} - V_{-1}] + ... \\ +d_{-1}[V_{-2} - V_{-1} - R_{-1}] + \gamma_1 d_1[V_1 - V_{-1}] + \psi[W_{-1} - V_{-1}] \end{cases} \quad (4)$$

$$rV_{-2} = \max_{x_{-2} \geq 0} \{\pi_{-2} - \lambda x_{-2} + [x_{-2} + (1-\gamma_2)d_2][V_{-1} - V_{-2}] + \gamma_2 d_2[V_0 - V_{-2}] + \psi[W_{-2} - V_{-2}]\} \quad (5)$$

$$rW_2 = \max_{y_2 \geq 0} \begin{cases} \pi_2' - \theta y_2 + y_2[W_1 - W_2] + (1-\phi_2)b_2[W_1 - W_2 - R_2] + ... \\ +\phi_2 b_2[W_0 - W_2 - R_2] + \psi'[V_2 - W_2] \end{cases} \quad (6)$$

$$rW_1 = \max_{y_1 \geq 0} \begin{cases} \pi_1' - \theta y_1 + y_1[W_0 - W_1] + (1-\phi_1)b_1[W_0 - W_1 - R_1] + ... \\ +\phi_1 b_1[W_{-1} - W_1 - R_1] + [y_{-1} + b_{-1}][W_2 - W_1] + \psi'[V_1 - W_1] \end{cases} \quad (7)$$

$$rW_0 = \max_{y_0 \geq 0} \begin{cases} \pi_0' - \theta y_0 + y_0[W_{-1} - W_0] + (1-\phi_0)b_0[W_{-1} - W_0 - R_0] + ... \\ +[y_0' + (1-\phi_0)b_0][W_1 - W_0] + \phi_0 b_0[(W_2 - W_0) + (W_{-2} - W_0 - R_0)] + \psi'[V_0 - W_0] \end{cases} \quad (8)$$

$$rW_{-1} = \max_{y_{-1} \geq 0} \begin{cases} \pi_{-1}' - \theta y_{-1} + y_{-1}[W_{-2} - W_{-1}] + b_{-1}[W_{-2} - W_{-1} - R_{-1}] + ... \\ +[y_1 + (1-\phi_1)b_1][W_0 - W_{-1}] + \phi_1 b_1[W_1 - W_{-1}] + \psi'[V_{-1} - W_{-1}] \end{cases} \quad (9)$$

$$rW_{-2} = \pi_{-2}' + [y_2 + (1-\phi_2)b_2][W_{-1} - W_{-2}] + \phi_2 b_2[W_0 - W_{-2}] + \psi'[V_{-2} - W_{-2}] \quad (10)$$

where x'_0 and y'_0 represent my opponent's strategies when I am in state 0. The left-hand side of each equation represents the rate of appreciation of the firm's value. On the right-hand side of each equation, the first term is flow profit. For equations with maximization, the second term is the cost of investment or disinvestment. The remaining terms give the intensities of each possible state change multiplied by their associated changes in continuation value.[15] Note that, because reorganization costs are one-time values, they appear only when state changes occur due to reorganization. I assume that the overall rates of bankruptcy are not so large as to make investment or disinvestment unappealing.

A symmetric Markov Perfect Equilibrium will comprise a set of investment and disinvestment strategies which maximize each player's value in each state conditional upon the same set of strategies being employed by the other player. Solving for equilibrium investment and disinvestment intensities, the details of which are given in the Appendix, yields the following:

$$
\begin{aligned}
x^*_{-2} &= \max\left\{0,\ \frac{\pi_2 - \pi_{-2} - R_2 d_2 - 4\theta\psi}{\lambda} - (4(r+\psi) + 2(1+\gamma_2)d_2)\right\} \\
x^*_{-1} &= \max\left\{0,\ \frac{\pi_1 - \pi_{-2} - R_1 d_1 - 3\theta\psi}{\lambda} - (3(r+\psi) + (1+\gamma_2)d_2 + (1+\gamma_1)d_1 - d_{-1})\right\} \\
x^*_{0} &= \max\left\{0,\ \frac{\pi_0 - \pi_{-2} - R_0 d_0 - 2\theta\psi}{\lambda} - (2(r+\psi) + (1+\gamma_2)d_2)\right\} \\
x^*_{1} &= \max\left\{0,\ \frac{\pi_{-1} - \pi_{-2} - R_{-1} d_{-1} - \theta\psi}{\lambda} - ((r+\psi) + (1+\gamma_2)d_2 - (1+\gamma_1)d_1 + d_{-1})\right\} \\
x^*_{2} &= 0
\end{aligned}
$$

[15]For example, the right-hand side of equation 1 is the flow profit in state 2, plus the opponent's investment rate times the change in value associated with a transition to state 1, plus the rate of a one-unit reorganization times its associated change in value, plus the rate of a two-unit reorganization times its associated change in value, plus the rate of demand transition times its associated change in value.

$$
\begin{aligned}
y^*_{-2} &= 0 \\
y^*_{-1} &= \max\left\{0,\ \frac{\pi'_1 - \pi'_2 + R_2 b_2 - R_1 b_1 - \lambda\psi'}{\theta} - \big((r+\psi') + (1+\phi_2)b_2 - (1+\phi_1)b_1 + b_{-1}\big)\right\} \\
y^*_0 &= \max\left\{0,\ \frac{\pi'_0 - \pi'_2 + R_2 b_2 - R_0 b_0 - 2\lambda\psi'}{\theta} - \big(2(r+\psi') + (1+\phi_2)b_2\big)\right\} \\
y^*_1 &= \max\left\{0,\ \frac{\pi'_{-1} - \pi'_2 + R_2 b_2 - R_{-1} b_{-1} - 3\lambda\psi'}{\theta} - \big(3(r+\psi') + (1+\phi_2)b_2 + (1+\phi_1)b_1 - b_{-1}\big)\right\} \\
y^*_2 &= \max\left\{0,\ \frac{\pi'_{-2} - \pi'_2 + R_2 b_2 - 4\lambda\psi'}{\theta} - \big(4(r+\psi') + 2(1+\phi_2)b_2\big)\right\}
\end{aligned}
$$

IV.B. Comparative Statics

Solving for equilibrium investment and disinvestment strategies reveals the two key features of capacity discipline at work: Higher reorganization costs slow investment in high-demand states and speed disinvestment in low-demand states. Intuitively, higher reorganization costs make disinvestment more expensive overall, increasing the risk of being large in a down market, thereby reducing the incentive to invest. At the same time, disinvestment outside of bankruptcy court protection becomes less expensive relative to filing Chapter 11, leading to quicker retraction outside of reorganization. The magnitude of each effect depends on the nature of competition between the duopolists. In particular, the disinvestment effect is stronger for more dominant firms, while the investment effect is stronger for weaker firms. While these effects do not directly describe how steady-state equilibrium industry structure changes with reorganization costs, the Appendix shows that the qualitative implications of this section continue to hold when we weight intensities by long-run probabilities.

The unnumbered equations in the previous section give explicit expressions for optimal investment/disinvestment. As we would expect, firms want to grow when demand is expected to be good, and they want to shrink when demand is expected to be bad. Investment decreases in the arrival rate of the low demand state, while disinvestment falls with the arrival rate of the high demand state. Similarly intuitive is the result that investment declines with the price of investment, and disinvestment falls with the cost of disinvestment. Finally, disinvestment and reorganization are seen as imperfect substitutes. Disinvestment falls with the arrival rate of default for the largest firm, as well as with the probability of "big" (i.e. two-increment) default for the largest firm.

We can analyze optimal investment/disinvestment rates to determine the impact of a change in bankruptcy policy. For example, an increase in the cost of reorganization, such as was effected in the United States by the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005,[16] is best proxied by an increase in the one-time reorganization costs $\{R_n\}$. The first and most intuitive effect of such a change is to reduce investment intensity during high-demand periods, as seen by $\frac{\partial x_n^*}{\partial R_{-n}} < 0, \; \forall n < 2$. This effect is stronger when investment costs (λ) are smaller and when the arrival rate of default for my rival (d_{-n}) is higher. If we further suppose that a legal reform has a larger impact on larger firms, such that $\Delta R_n > \Delta R_{n-1}$, we should expect the investment effect to be strongest for small firms and weakest for large firms because it is my rival's reorganization costs that impact my equilibrium investment rate.

The other component of capacity discipline is greater eagerness to disinvest during downturns, which we find in $\frac{\partial y_n^*}{\partial R_2} > 0$. Increasing the cost of reorganization for only the largest organizations (i.e. $n = 2$) increases disinvestment rates at all relevant levels.[17] However, if we assume an across-the-board increase in reorganzation costs, this effect will be tempered by my rival's expected cost of default. If we again assume that $\Delta R_n > \Delta R_{n-1}$, then the overall effect of a legal reform that increases the cost of reorganization, especially for the largest of firms, will indeed be faster disinvestment. Moreover, the effect will be stronger the larger is the firm. Thus, on the whole, larger firms will have a stronger desire to get smaller, but a weaker desire to get larger.

[16] See Mazur (2017) for a thorough explanation of the reform in the context of strategic capital investment and bankrupcty decisions in the U.S. airline industry.

[17] The lowest level, $n = -2$, cannot disinvest.

IV.C. Conclusion

The key takeaway of this paper is that reorganization under Chapter 11 can influence oligopoly investment behavior independent from the limited liability and strategic bankrupcty effects of Brander and Lewis (1986, 1988) or any capital-structure-related investment effects. It is imperative to express the distinction here between the risk of liquidation and the possibility of reorganization. Heretofore the industrial organization literature on this subject has viewed bankruptcy as liquidation, an exit event that leaves the firm (or its managers) with nothing. Not surprisingly, actions that expose the firm and/or its managers to this risk will have implications for how they behave and how their behavior influences rivals in the product market. However, the actual prospect of bankruptcy, especially in the United States, is considerably less grim. The main alternative to liquidation under Chapter 7 of the U.S. Bankruptcy Code is reorganization under Chapter 11, which retains a great deal of hope for socially beneficial emergence from bankruptcy. Moreover, successful emergence is not typically effected by changes in financial structure alone, but by thorough reevaluation and careful pruning of the company's operations. The present paper focuses on one salient and non-financial aspect of Chapter 11, namely, that contracts which might otherwise prevent the firm from engaging in such pruning, can be modifed, even abrogated, in bankruptcy.

I have presented a straightforward theoretical model that predicts capacity discipline as an outcome of stricter bankruptcy policy. This prediction should apply to any industry with heavy contractual investment and volatile demand, suggesting an important and heretofore undiscussed consideration for bankruptcy law reform, both in the United States and abroad. As such, this analysis and its extensions should be of great interest to students of corpoate bankrupty law, corporate finance, and industrial organization. Airlines, steel, auto manufacturing, telecommunications, and even retail conform to this pattern. The discipline engendered by a more creditor-friendly Chapter 11 should correlate positively with an industry's degree of long-run contract usage and demand volatility, a hypothesis to be tested in future research.

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A.1. Duopoly Solution

Following Acemoglu and Akcigit (2012), solving for the value functions is easy. Since costs are linear, any non-zero investment level must satisfy

$$V_{n+1} - V_n = \lambda \text{ for } n \in \{-2, -1, 0, 1\} \tag{11}$$

and any non-zero disinvestment level must satisfy

$$W_n - W_{n+1} = \theta \text{ for } n \in \{-1, 0, 1, 2\} \tag{12}$$

per the first-order conditions for each optimization problem. Combining (11) and (5) gives

$$V_{-2} = \frac{\pi_{-2} + \lambda(1 + \gamma_2)d_2 + \psi W_{-2}}{r + \psi}$$

Similarly, combining (12) and (6) yields

$$W_2 = \frac{\pi_2' + \theta(1 + \phi_2)b_2 + \psi' V_2 - R_2 b_2}{r + \psi'}$$

According to (11) and (12), we know that $V_2 = V_{-2} + 4\lambda$ and $W_{-2} = W_2 + 4\theta$. These conditions give us a solvable system of two equations:

$$V_2 = \frac{\pi_{-2} + \lambda(1 + \gamma_2)d_2}{r + \psi} + 4\lambda + \frac{\psi W_{-2}}{r + \psi} \tag{13}$$

$$W_{-2} = \frac{\pi_2' + \theta(1 + \phi_2)b_2 - R_2 b_2}{r + \psi'} + 4\theta + \frac{\psi' V_2}{r + \psi'} \tag{14}$$

It turns out we don't even need to solve the system, though. We can use everything we have so far to get expressions for optimal investment in each state. First, combine (11) with (1)-(4) and (12) with (7)-(10) to get expressions in terms of value functions, assuming investment and disinvestment are always positive.

$$x^*_{-2} = \frac{\pi_2 - R_2 d_2 - \lambda(1+\gamma_2)d_2 + \psi W_2 - (r+\psi)V_2}{\lambda} \tag{15}$$

$$x^*_{-1} = \frac{\pi_1 - R_1 d_1 + \lambda d_{-1} - \lambda(1+\gamma_1)d_1 + \psi W_1 - (r+\psi)V_1}{\lambda} \tag{16}$$

$$x^*_0 = \frac{\pi_0 - R_0 d_0 + \psi W_0 - (r+\psi)V_0}{\lambda} \tag{17}$$

$$x^*_1 = \frac{\pi_{-1} - R_{-1} d_{-1} + \lambda(1+\gamma_1)d_1 - \lambda d_{-1} + \psi W_{-1} - (r+\psi)V_{-1}}{\lambda} \tag{18}$$

$$x^*_2 = 0 \tag{19}$$

$$y^*_{-2} = 0 \tag{20}$$

$$y^*_{-1} = \frac{\pi'_1 - R_1 b_1 + \theta(1+\phi_1)b_1 - \theta b_{-1} + \psi' V_1 - (r+\psi')W_1}{\theta} \tag{21}$$

$$y^*_0 = \frac{\pi'_0 - R_0 b_0 + \psi' V_0 - (r+\psi')W_0}{\theta} \tag{22}$$

$$y^*_1 = \frac{\pi'_{-1} - R_{-1} b_{-1} + \theta b_{-1} - \theta(1+\phi_1)b_1 + \psi' V_{-1} - (r+\psi')W_{-1}}{\theta} \tag{23}$$

$$y^*_2 = \frac{\pi'_{-2} - \theta(1+\phi_2)b_2 + \psi' V_{-2} - (r+\psi')W_{-2}}{\theta} \tag{24}$$

Next, rewrite (13) and (14) as follows

$$\begin{aligned} \psi W_{-2} - (r+\psi)V_2 &= -\left(\pi_{-2} + \lambda(1+\gamma_2)d_2 + (r+\psi)4\lambda\right) \\ \psi' V_2 - (r+\psi')W_{-2} &= -\left(\pi'_2 + \theta(1+\phi_2)b_2 - R_2 b_2 + (r+\psi')4\theta\right) \end{aligned}$$

and recall that

$$\begin{aligned} W_{-2} &= W_{-1} + \theta = W_0 + 2\theta = W_1 + 3\theta = W_2 + 4\theta \\ V_2 &= V_1 + \lambda = V_0 + 2\lambda = V_{-1} + 3\lambda = V_{-2} + 4\lambda \end{aligned}$$

Then we need not even solve explicitly for either value function. We can simply substitute the expressions above into (15)-(24). Starting from the top, let's sub in for investment intensities:

$$\begin{aligned}
x^*_{-2} &= \frac{\pi_2 - R_2 d_2 - \lambda(1+\gamma_2)d_2 + \psi W_2 - (r+\psi)V_2}{\lambda} \\
&= \frac{\pi_2 - R_2 d_2 - \lambda(1+\gamma_2)d_2 + \psi(W_{-2} - 4\theta) - (r+\psi)V_2}{\lambda} \\
&= \frac{\pi_2 - R_2 d_2 - \lambda(1+\gamma_2)d_2 - (\pi_{-2} + \lambda(1+\gamma_2)d_2 + (r+\psi)4\lambda) - \psi 4\theta}{\lambda} \\
&= \frac{\pi_2 - \pi_{-2} - R_2 d_2 - 4\theta\psi}{\lambda} - (4(r+\psi) + 2(1+\gamma_2)d_2)
\end{aligned}$$

$$\begin{aligned}
x^*_{-1} &= \frac{\pi_1 - R_1 d_1 + \lambda d_{-1} - \lambda(1+\gamma_1)d_1 + \psi W_1 - (r+\psi)V_1}{\lambda} \\
&= \frac{\pi_1 - R_1 d_1 + \lambda d_{-1} - \lambda(1+\gamma_1)d_1 + \psi(W_{-2} - 3\theta) - (r+\psi)(V_2 - \lambda)}{\lambda} \\
&= \frac{\pi_1 - R_1 d_1 + \lambda d_{-1} - \lambda(1+\gamma_1)d_1 - (\pi_{-2} + \lambda(1+\gamma_2)d_2 + (r+\psi)4\lambda) - \psi 3\theta + \lambda(r+\psi)}{\lambda} \\
&= \frac{\pi_1 - \pi_{-2} - R_1 d_1 - 3\theta\psi}{\lambda} - (3(r+\psi) + (1+\gamma_2)d_2 + (1+\gamma_1)d_1 - d_{-1})
\end{aligned}$$

$$\begin{aligned}
x^*_0 &= \frac{\pi_0 - R_0 d_0 + \psi W_0 - (r+\psi)V_0}{\lambda} \\
&= \frac{\pi_0 - R_0 d_0 + \psi(W_{-2} - 2\theta) - (r+\psi)(V_2 - 2\lambda)}{\lambda} \\
&= \frac{\pi_0 - R_0 d_0 - (\pi_{-2} + \lambda(1+\gamma_2)d_2 + (r+\psi)4\lambda) - \psi 2\theta + 2\lambda(r+\psi)}{\lambda} \\
&= \frac{\pi_0 - \pi_{-2} - R_0 d_0 - 2\theta\psi}{\lambda} - (2(r+\psi) + (1+\gamma_2)d_2)
\end{aligned}$$

$$\begin{aligned}
x^*_1 &= \frac{\pi_{-1} - R_{-1}d_{-1} + \lambda(1+\gamma_1)d_1 - \lambda d_{-1} + \psi W_{-1} - (r+\psi)V_{-1}}{\lambda} \\
&= \frac{\pi_{-1} - R_{-1}d_{-1} + \lambda(1+\gamma_1)d_1 - \lambda d_{-1} + \psi(W_{-2} - \theta) - (r+\psi)(V_2 - 3\lambda)}{\lambda} \\
&= \frac{\pi_{-1} - R_{-1}d_{-1} + \lambda(1+\gamma_1)d_1 - \lambda d_{-1} - (\pi_{-2} + \lambda(1+\gamma_2)d_2 + (r+\psi)4\lambda) - \psi\theta + 3\lambda(r+\psi)}{\lambda} \\
&= \frac{\pi_{-1} - \pi_{-2} - R_{-1}d_{-1} - \theta\psi}{\lambda} - ((r+\psi) + (1+\gamma_2)d_2 - (1+\gamma_1)d_1 + d_{-1})
\end{aligned}$$

And now, disinvestment intensities:

$$\begin{aligned}
y^*_{-1} &= \frac{\pi'_1 - R_1b_1 + \theta(1+\phi_1)b_1 - \theta b_{-1} + \psi' V_1 - (r+\psi')W_1}{\theta} \\
&= \frac{\pi'_1 - R_1b_1 + \theta(1+\phi_1)b_1 - \theta b_{-1} + \psi'(V_2 - \lambda) - (r+\psi')(W_{-2} - 3\theta)}{\theta} \\
&= \frac{\pi'_1 - R_1b_1 + \theta(1+\phi_1)b_1 - \theta b_{-1} - (\pi'_2 + \theta(1+\phi_2)b_2 - R_2b_2 + (r+\psi')4\theta) - \lambda\psi' + (r+\psi')3\theta}{\theta} \\
& \quad \frac{\pi'_1 - \pi'_2 + R_2b_2 - R_1b_1 - \lambda\psi'}{\theta} - ((r+\psi') + (1+\phi_2)b_2 - (1+\phi_1)b_1 + b_{-1})
\end{aligned}$$

$$\begin{aligned}
y^*_0 &= \frac{\pi'_0 - R_0b_0 + \psi' V_0 - (r+\psi')W_0}{\theta} \\
&= \frac{\pi'_0 - R_0b_0 + \psi'(V_2 - 2\lambda) - (r+\psi')(W_{-2} - 2\theta)}{\theta} \\
&= \frac{\pi'_0 - R_0b_0 - (\pi'_2 + \theta(1+\phi_2)b_2 - R_2b_2 + (r+\psi')4\theta) - 2\lambda\psi' + (r+\psi')2\theta}{\theta} \\
&= \frac{\pi'_0 - \pi'_2 + R_2b_2 - R_0b_0 - 2\lambda\psi'}{\theta} - (2(r+\psi') + (1+\phi_2)b_2)
\end{aligned}$$

$$\begin{aligned}
y^*_1 &= \frac{\pi'_{-1} - R_{-1}b_{-1} + \theta b_{-1} - \theta(1+\phi_1)b_1 + \psi' V_{-1} - (r+\psi')W_{-1}}{\theta} \\
&= \frac{\pi'_{-1} - R_{-1}b_{-1} + \theta b_{-1} - \theta(1+\phi_1)b_1 + \psi'(V_2 - 3\lambda) - (r+\psi')(W_{-2} - \theta)}{\theta} \\
&= \frac{\pi'_{-1} - R_{-1}b_{-1} + \theta b_{-1} - \theta(1+\phi_1)b_1 - (\pi'_2 + \theta(1+\phi_2)b_2 - R_2b_2 + (r+\psi')4\theta) - 3\lambda\psi' + (r+\psi')\theta}{\theta} \\
&= \frac{\pi'_{-1} - \pi'_2 + R_2b_2 - R_{-1}b_{-1} - 3\lambda\psi'}{\theta} - (3(r+\psi') + (1+\phi_2)b_2 + (1+\phi_1)b_1 - b_{-1})
\end{aligned}$$

$$\begin{aligned}
y^*_2 &= \frac{\pi'_{-2} - \theta(1+\phi_2)b_2 + \psi' V_{-2} - (r+\psi')W_{-2}}{\theta} \\
&= \frac{\pi'_{-2} - \theta(1+\phi_2)b_2 + \psi'(V_2 - 4\lambda) - (r+\psi')W_{-2}}{\theta} \\
&= \frac{\pi'_{-2} - \theta(1+\phi_2)b_2 - (\pi'_2 + \theta(1+\phi_2)b_2 - R_2b_2 + (r+\psi')4\theta) - 4\lambda\psi'}{\theta} \\
&= \frac{\pi'_{-2} - \pi'_2 + R_2b_2 - 4\lambda\psi'}{\theta} - (4(r+\psi') + 2(1+\phi_2)b_2)
\end{aligned}$$

Summarizing, the set of investment and disinvestment intensities is as follows:

$$
\begin{aligned}
x^*_{-2} &= \max\left\{0,\ \frac{\pi_2 - \pi_{-2} - R_2 d_2 - 4\theta\psi}{\lambda} - (4(r+\psi) + 2(1+\gamma_2)d_2)\right\} \\
x^*_{-1} &= \max\left\{0,\ \frac{\pi_1 - \pi_{-2} - R_1 d_1 - 3\theta\psi}{\lambda} - (3(r+\psi) + (1+\gamma_2)d_2 + (1+\gamma_1)d_1 - d_{-1})\right\} \\
x^*_0 &= \max\left\{0,\ \frac{\pi_0 - \pi_{-2} - R_0 d_0 - 2\theta\psi}{\lambda} - (2(r+\psi) + (1+\gamma_2)d_2)\right\} \\
x^*_1 &= \max\left\{0,\ \frac{\pi_{-1} - \pi_{-2} - R_{-1} d_{-1} - \theta\psi}{\lambda} - ((r+\psi) + (1+\gamma_2)d_2 - (1+\gamma_1)d_1 + d_{-1})\right\} \\
x^*_2 &= 0
\end{aligned}
$$

$$
\begin{aligned}
y^*_{-2} &= 0 \\
y^*_{-1} &= \max\left\{0,\ \frac{\pi'_1 - \pi'_2 + R_2 b_2 - R_1 b_1 - \lambda\psi'}{\theta} - ((r+\psi') + (1+\phi_2)b_2 - (1+\phi_1)b_1 + b_{-1})\right\} \\
y^*_0 &= \max\left\{0,\ \frac{\pi'_0 - \pi'_2 + R_2 b_2 - R_0 b_0 - 2\lambda\psi'}{\theta} - (2(r+\psi') + (1+\phi_2)b_2)\right\} \\
y^*_1 &= \max\left\{0,\ \frac{\pi'_{-1} - \pi'_2 + R_2 b_2 - R_{-1} b_{-1} - 3\lambda\psi'}{\theta} - (3(r+\psi') + (1+\phi_2)b_2 + (1+\phi_1)b_1 - b_{-1})\right\} \\
y^*_2 &= \max\left\{0,\ \frac{\pi'_{-2} - \pi'_2 + R_2 b_2 - 4\lambda\psi'}{\theta} - (4(r+\psi') + 2(1+\phi_2)b_2)\right\}
\end{aligned}
$$

A.2 Duopoly Implications: Steady-State

While investment rates are informative, they do not tell the whole story. The distribution of industry structures in equilibrium may change when R_n changes. Therefore, we compute the steady-state distribution, μ, a vector of long-run probabilities. The long-run rate at which the process leaves state i must equal the sum of the long-run rates at which the process enters state i. The steady-state vector μ is a solution to

$$\begin{aligned} \mu' Q &= 0 \\ \sum_i \mu_i &= 1 \end{aligned}$$

where Q is the infinitesimal generator, or the intensity matrix, of the continuous-time Markov process and has elements q_{ij}. The matrix Q corresponds to the matrix $P - I$ in discrete-time Markov processes. The row sums in Q are zero, such that

$$q_{ii} \equiv \sum_{j=1, j \neq i}^{N} -q_{ij}$$

Given our equilibrium (dis)investment intensities, we can construct Q as follows:

$$Q = \begin{matrix} q_{11} & d_2(1-\gamma_2) + x_{-2} & d_2\gamma_2 & \psi & 0 & 0 \\ x_1 + d_{-1} & q_{22} & x_{-1} + (1-\gamma_1)d_1 & 0 & \psi & 0 \\ 2\gamma_0 d_0 & 2\left(x_0 + (1-\gamma_0)d_0\right) & q_{33} & 0 & 0 & \psi \\ \psi' & 0 & 0 & q_{44} & b_2(1-\phi_2) + y_2 & b_2\phi_2 \\ 0 & \psi' & 0 & y_{-1} + b_{-1} & q_{55} & y_1 + (1-\phi_1)b_1 \\ 0 & 0 & \psi' & 2\phi_0 b_0 & 2\left(y_0 + (1-\phi_0)b_0\right) & q_{66} \end{matrix}$$

The condition $\mu' Q = 0$ yields the balance equations

$$\mu_i q_i = \sum_{j=1, j \neq i}^{N} \mu_j q_{ji}$$

which we express in long form as

$$
\begin{aligned}
u_2\left(x_1+d_{-1}\right)+u_3 2\gamma_0 d_0+u_4\psi' &= u_1\left(d_2+x_{-2}+\psi\right) && (25)\\
u_1\left(d_2(1-\gamma_2)+x_{-2}\right)+u_3 2\left(x_0+(1-\gamma_0)d_0\right)+u_5\psi' &= u_2\left(x_1+d_{-1}+x_{-1}+(1-\gamma_1)d_1+\psi\right) && (26)\\
u_1 d_2\gamma_2+u_2\left(x_{-1}+(1-\gamma_1)d_1\right)+u_6\psi' &= u_3\left(2x_0+2d_0+\psi\right) && (27)\\
u_5\left(y_{-1}+b_{-1}\right)+u_6 2\phi_0 b_0+u_1\psi &= u_4\left(b_2+y_2+\psi'\right) && (28)\\
u_4\left(b_2(1-\phi_2)+y_2\right)+u_6 2\left(y_0+(1-\phi_0)b_0\right)+u_2\psi &= u_5\left(y_{-1}+b_{-1}+y_1+(1-\phi_1)b_1+\psi'\right) && (29)\\
u_4 b_2\phi_2+u_5\left(y_1+(1-\phi_1)b_1\right)+u_3\psi &= u_6\left(2y_0+2b_0+\psi'\right) && (30)\\
u_1+u_2+u_3+u_4+u_5+u_6 &= 1 && (31)
\end{aligned}
$$

When constraint (31) is substituted in, the system can be solved for μ. The expression, which is many pages long, is available upon request. Absent a simplified expression, we can parameterize the model and see whether changes in R_n have the same effect in steady-state as they do on the intensities for a given level. To illustrate, Figure A.1 presents the steady-state distribution of investment and disinvestment intensities as functions of reorganization cost for a parameterization of the theoretical model. For this particular parameterization, steady-state investment in upturns falls with R, while steady-state disinvestment in downturns rises with R.

Figure A.1
Equilibrium Intensities