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Eat or Be Eaten: A Theory of Mergers and Firm Size

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ABSTRACT

We propose a theory of mergers that combines managerial merger motives with an industry-level regime shift that may lead to value-increasing merger opportunities. Anticipation of these merger opportunities can lead to defensive acquisitions, where managers acquire other firms to avoid losing private benefits if their firms are acquired, or "positioning" acquisitions, where firms position themselves as more attractive takeover targets to earn takeover premia. The identity of acquirers and targets and the profitability of acquisitions depend on the distribution of firm sizes within an industry, among other factors. We find empirical support for some unique predictions of our theory.

THE 1990S PRODUCED THE GREATEST WAVE of mergers in U.S. history. Between 1995 and 2000, U.S. merger volume set a new record every year, reaching about $1.8 trillion in 2000.[1] Merger activity then fell sharply, dropping to under $500 billion in 2002, before increasing again to about $1.6 trillion in 2007.[2] Because of the growth and importance of mergers, a substantial academic literature has developed to examine them. However, existing

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[1] See *Fortune*, 1999, "The Year of the Mega Merger . . . ," January 11; *Dow Jones News Service*, 1999, "Tales of the Tape: '99 M&A Vol Hits Record . . . ," December 29; and *The Wall Street Journal*, 2001, "Year-End Review of Markets & Finance 2000—Market Swoon Stifles M&A's Red-Hot Start . . . ," January 2.

[2] See *The Wall Street Journal*, 2003, "Year-End Review of Markets & Finance 2002—Merger Market Gets Year-End Jump-Start . . . ," January 2; and *The Wall Street Journal*, 2008, "Year-End Review of Markets & Finance 2007—For Deal Makers, Tale of Two Halves . . . ," January 2.

merger theories remain unable to reconcile certain key facts about merger activity.

Two of the most important stylized facts about mergers are the following: First, the stock price of the acquirer in a merger decreases on average when the merger is announced.[3] Recent work shows that this result is driven by negative announcement returns for very large acquirers, while small acquirers tend to gain in acquisitions (Moeller, Schlingemann, and Stulz (2004)). Second, mergers concentrate in industries that have experienced regime shifts in technology or regulation. Mergers may provide an efficient and value-maximizing response for firms to such a regime shift (see, for example, Mitchell and Mulherin (1996), Andrade, Mitchell, and Stafford (2001), and Andrade and Stafford (2004)).

The view that mergers are an efficient response to regime shifts by value-maximizing managers, the so-called neoclassical merger theory (see, for example, Mitchell and Mulherin (1996), Weston, Chung, and Siu (1998), and Jovanovic and Rousseau (2001, 2002)), can explain the second stylized fact. However, it has difficulties explaining negative abnormal returns to acquirers. Theories based on managerial self-interest such as a desire for larger firm size and diversification (for example, Morck, Shleifer, and Vishny (1990)) can explain negative acquirer returns.[4] However, they cannot explain why mergers are concentrated in industries undergoing a regime shift.

In this paper, we provide a theory of mergers that combines elements from both these schools of thought. The notion of a regime shift that *may* make mergers an efficient choice for firms remains a key part of our analysis. However, one particular managerial motive, namely, the desire not to be acquired, is also important. Our theory of mergers is able to reconcile the two previously mentioned stylized facts. It also explains a third important characteristic of mergers, the fact that they often come in waves. Firm size plays a key role in our theory, consistent with the differing findings on acquirer returns for small and large firms.

The basic elements of our theory are as follows: First, we assume that managers derive private benefits from operating a firm in addition to the value of any ownership share of the firm they have. This means that self-interested managers may have a preference for keeping their firms independent, since

[3] Studies that find negative average returns to bidders include Asquith, Bruner, and Mullins (1987), Banerjee and Owers (1992), Byrd and Hickman (1992), Servaes (1991), and Varaiya and Ferris (1987). See Table 8–6 in Gilson and Black (1995). Bradley and Sundaram (2004) find, using a much larger sample of mergers in the 1990s, that most acquirers experience positive announcement returns. The negative announcement returns are concentrated among stock-financed acquisitions of public targets that are large relative to the acquirer.

[4] Other papers in which managerial motivations for mergers are prominent include Amihud and Lev (1981), Shleifer and Vishny (1989), and May (1995). Gort (1969) argues that economic disturbances or shocks, such as rapid changes in technology, generate discrepancies in valuations that in turn lead to mergers. Negative acquirer announcement returns can be explained without appealing to agency conflicts between managers and owners by the argument that the takeover announcement reveals negative information about the acquirer's profitability relative to expectations (see McCardle and Viswanathan (1994) and Jovanovic and Braguinsky (2004)). Alternatively, one can appeal to hubris (Roll (1986)).

managers of acquired firms may lose private benefits, as they are likely to either play a subordinated role in the new firms or lose their jobs (Jensen and Ruback (1983), Ruback (1988)).

Second, we assume that there is a regime shift that creates potential synergies. The regime shift makes it more likely that some future mergers will create value, with larger targets being more attractive merger partners due to economies of scale. As a consequence, firm size is an important determinant of which firms are takeover targets. We assume that the value-creating merger opportunities are uncertain, with a small enough ex ante probability that mergers do not create positive expected synergies.

Third, we assume that a firm can only acquire a smaller firm. While this is an assumption in our model, there are reasons why we rarely see firms acquire larger rivals. For one, a larger acquisition is more difficult to finance. Typically, it is more difficult to raise funds by issuing debt for a larger acquisition. Adding a lot of debt can also substantially increase the chance of financial distress, and managers of financially distressed firms are more likely to lose their jobs (see Gilson (1989)). Alternatively, acquiring a larger company with stock would dilute the acquirer's ownership of the combined company and perhaps lead to a loss of control for incumbent management. These difficulties in acquiring larger companies may explain why in most mergers the acquirer is considerably larger than the target and why the probability of being a target decreases as firm size increases (e.g., see Hasbrouck (1985) and Palepu (1986)).

In our models, the anticipation of potential mergers after the regime shift creates incentives to engage in additional mergers. We show that a race to increase firm size through mergers can ensue for either defensive or "positioning" reasons. Defensive mergers occur because when managers care sufficiently about staying in control, they may want to acquire other firms to avoid being acquired themselves. By growing larger through acquisition, a firm is less likely to be acquired as it becomes bigger than some rivals. This defensive merger motive is self-reinforcing and hence gives rise to merger waves: One firm's defensive acquisition makes other firms more vulnerable as takeover targets, which induces them to make defensive acquisitions themselves. This leads to an "eat-or-be-eaten" scenario, whereby unprofitable defensive acquisitions preempt some or all profitable acquisitions.[5] We show that in industries in which many firms are of similar size to the largest firm, defensive mergers are likely to occur.

Besides defensive motives, there is another reason why the anticipation of efficient mergers can lead to a race for firm size. Since the synergies from

[5] Many articles in the press or trade journals mention the idea that if firms do not make acquisitions, they may become targets themselves. Often, they refer to the ensuing merger dynamics as "eat or be eaten" (see, for example, *The New York Times*, 1994, "For Military Contractors, It's Buy or Be Bought," March 12; *Los Angeles Times*, 1998, "Phone Giants Reportedly Mulling Merger," May 11; and *Bank Mergers & Acquisitions*, 2002, "Middle-market M&A players: Where are they now?," August 1). Sometimes these articles explicitly discuss the role that firm size can play in who can acquire whom (see, for example, *KRTBN Knight-Ridder Tribune Business News: The Boston Globe – Massachusetts*, 1999, "New England Utility Mergers Raise Question over Boston Edison's Future," June 16; and *Los Angeles Times*, 1994, "Takeover Rumors Fuel Another Rise in Amgen Stock . . . ," August 30).

efficient mergers are increasing in size (because of economies of scale), a firm can become a more attractive takeover target by becoming larger. We show that in industries in which there is a dominant firm, such positioning mergers are likely. In these industries, no merger ensures that a firm becomes large enough that it cannot be acquired by the largest firm. Indeed, acquiring another firm has the opposite effect of making the firm a more attractive takeover target. If managers care enough about preserving the independence of their firms, they *avoid* acquisitions. But, if managers care a lot about firm value, they may engage in acquisitions in order to position their firms as *more* attractive targets since being acquired generates a takeover premium for the target (and thus for its manager). All acquisitions are profitable, because the early acquisitions are undertaken to increase the likelihood of being the target in a wealth-creating merger later. Here, merger waves occur only if managers care sufficiently about maximizing firm value (in contrast to the case of industries in which many firms are of similar size, where waves occur when managers care more about private benefits).

We also consider an industry structure where both defensive and positioning mergers are possible. In an industry in which some but not all firms are of similar size, medium-sized firms have the opportunity to make defensive acquisitions as well as positioning acquisitions. In these industries, the pattern of mergers depends crucially on firm size and the level of managerial private benefits. We show that the profitability of acquisitions is generally decreasing as the acquirer's size grows. Large firms engage only in defensive, unprofitable acquisitions, and these only occur when private benefits are high.[6] Medium-sized firms engage in unprofitable defensive acquisitions when private benefits are high, but when private benefits are low, they engage in profitable positioning acquisitions. The profitability of their acquisitions decreases as the size of the target increases relative to that of the acquirer. Finally, small firms typically engage in profitable acquisitions.[7] These industries with firms of varying sizes are most likely to exhibit merger waves, because some firms have defensive as well as positioning merger motives. Which motive predominates depends on a manager's interest in maximizing firm value.

Overall, our models show that firm size becomes the driving force for merger dynamics in industries with economies of scale. This can lead to profitable acquisitions. However, if a firm is very large and its manager's private benefits are high, it may engage in an unprofitable defensive acquisition.

Our theory can explain the three stylized facts about mergers mentioned earlier. It also generates a number of other empirical predictions. For example, we predict that (1) acquirer returns are negatively correlated with acquirer size (consistent with the results in Moeller, Schlingemann, and Stulz (2004)); (2) acquirer returns for medium-sized firms decrease as the ratio of target to

[6] In our model, the largest firm makes only profitable acquisitions because it has no defensive motives. However, we view this firm as a modeling device. This is discussed in more detail in Section IV.

[7] However, there is one unprofitable acquisition by a small firm for very high private benefits in our model.

acquirer size increases; and (3) medium-sized firms are most likely to acquire other firms. However, we caution that the notion of size in our models, namely, size relative to the largest firm in the industry with a profitable acquisition opportunity, is slightly different from absolute size.

Another implication of our models is that the firm size distribution in an industry matters for merger dynamics. This implication is central to our theory. In particular, our models predict that acquisition profitability is positively correlated with the ratio of the size of the largest firm in an industry to the size of other firms in the industry. Additionally, it predicts that firms in industries with more medium-sized firms have a higher probability of making acquisitions. We use data on U.S. mergers during the period from 1982 to 2000 to test these hypotheses and find support for them.

Our paper is related to several other papers. Harris (1994) presents a model that determines which firm is the acquirer and which firm is the target in a merger that is always value-increasing. She also assumes that managers have a preference for being the acquirer rather than the target in an acquisition. Her model is static and has only two firms. In contrast, we analyze merger dynamics involving several firms. This allows us to generate results on merger waves and the effect of the distribution of firm size in an industry on the merger dynamics, the identity of acquirers and targets, and the profitability of acquisitions. Toxvaerd (2008) analyzes strategic merger waves. Acquirers compete over time for a scarce set of targets. The trade-off between the option value of waiting for better market conditions and the fear of being preempted by other acquirers and hence being left without a merger partner determine merger timing. This can give rise to strategic merger waves. Fauli-Oller (2000) presents a model with nonstrategic as well as strategic merger incentives. Mergers can come in waves because early mergers increase the profitability of later mergers (see also Nilssen and Sørgard (1998)). Fridolfsson and Stennek (2005) argue that a firm may want to acquire another firm to preempt a rival from acquiring its target. While both potential acquirers would be better off if there were no acquisition, the acquisition is in the interest of shareholders (although postacquisition profits are lower) since it avoids a worse alternative (the rival making the acquisition and having lower costs, which would lead to even lower profits). Managerial acquisition incentives or the importance of size as a takeover deterrent do not play a role in these papers.

There are a number of other important papers on mergers. Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004) contend that merger waves are driven by misvaluations in the stock market.[8] Roll (1986) argues that acquirers may overpay because managers may fall prey to hubris.[9] Lambrecht (2004) and Morellec and Zhdanov (2005) emphasize the real options aspects of

[8] For empirical evidence supporting this theory, see Ang and Cheng (2006), Dong et al. (2006), and Rhodes-Kropf, Robinson, and Viswanathan (2005). However, Harford (2005) finds that industry shocks and sufficient liquidity in the capital markets are more important in causing merger waves than market timing attempts by managers.

[9] For empirical evidence supporting the hubris hypothesis, see, for example, Rau and Vermaelen (1998) and Malmendier and Tate (2007).

merger decisions. While we abstract from all these issues, we do not mean to suggest that they do not have an important impact on mergers.

Our paper is also related to the Industrial Organization literature on mergers (e.g., Berry and Pakes (1993), Gowrisankaran (1999), Epstein and Rubinfeld (2001), and Peters (2006)). This literature illustrates many of the modeling issues that must be confronted in analyzing mergers. In order to make the models tractable and reduce the potentially large multiplicity of equilibria, one has to make strong assumptions concerning the assumed choice of merger decision protocol (e.g., the order in which firms decide on whether to merge), the division of any surplus between merging entities, and so on, typically taking a specific industry size distribution as given.[10] We also have to make strong assumptions on these issues to keep our models tractable.

The remainder of the paper is structured as follows. In Section I, we present the basic model and illustrate how unprofitable defensive acquisitions can occur if firms are of similar size. We also offer a preview of the results from the models in the remainder of the paper. Moreover, we give the first of three different industrial organization structures, that is, different distributions of firm size, and use it to show why defensive mergers can come in waves. In Section II, we consider a model with a dominant firm. In Section III, we analyze a model in which some but not all firms are of similar size. We discuss some assumptions of our models in Section IV, and we present the empirical implications of our theory in Section V. In Section VI, we briefly present some empirical tests, and in Section VII we conclude.

I. Industries with Firms of Similar Size: Defensive Mergers

Section I.A presents the basic model. It has three firms, the minimum number needed to generate interesting results. The other models below are variations of this model and have the same basic structure but are more complicated and involve more firms. The basic model is rich enough to allow for defensive acquisitions where managers can preserve their private benefits (in our model, this is equivalent to keeping their jobs). It does not have a role for value-increasing positioning acquisitions, which are undertaken to increase the chance of the firm being taken over. A model of positioning mergers is presented in Section II.

A. The Basic Model

The simplest way to model managerial motivations for mergers is using two dates, 0 and 1, and three firms. The sequence of events is shown in Figure 1a.

The three firms are ordered by their size (stand-alone value) C_i, with $C_1 > C_2 > C_3$, that is, Firm 1 is the largest and Firm 3 the smallest (we always

[10] These models often cannot be solved analytically. However, Gowrisankaran and Holmes (2004) analytically study the effect of mergers on industry concentration. Perry and Porter (1985) analytically determine the incentives to engage in horizontal mergers in two different oligopolistic industry structures.

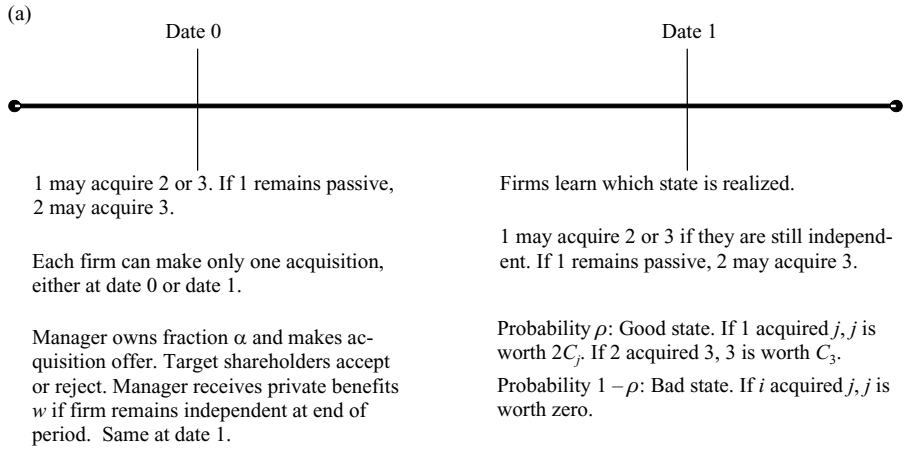

Figure 1a. Timeline for basic model in Section I.A.

assume that firms are ordered by size, with Firm i larger than Firm j if $i < j$).[11] We assume that firms cannot acquire firms that are larger than they are (and thus Firm 3 cannot acquire any firm). Hence, the larger a firm is, the fewer potential acquirers it has. As we discussed in the Introduction, there are probably fewer buyers for larger firms since acquiring a larger firm requires more resources and is more likely to lead to a loss of control.[12] To make the model interesting, we assume that $C_2 + C_3 > C_1$, that is, that after Firm 2 acquires Firm 3, it is larger than Firm 1 and hence cannot be acquired. This gives Firm 2 a potential defensive incentive to acquire Firm 3.

At each date, a manager receives private benefits of $w > 0$ if his firm is not acquired and zero if it is acquired.[13] The manager of each firm also owns a share α of his firm, which, for simplicity, is exogenous. All firms resolve indifference between acquiring and not acquiring in favor of not acquiring, perhaps due to unmodeled transactions costs. We assume that contracts

[11] In interpreting our models, it should be recognized that antitrust laws put some restrictions on intraindustry or horizontal mergers. This is one reason why the largest firm with a profitable acquisition opportunity (Firm 1) may not necessarily be the largest firm in the industry. Our model considers mergers within an industry that are allowed by antitrust law.

[12] As mentioned in the Introduction, it has been found that the probability of being a target in an acquisition is decreasing in a firm's size (see, e.g., Hasbrouck (1985) and Palepu (1986)).

[13] In reality, private benefits differ across firms and managers, and arguably increase in firm size. In a model that captures this cross-sectional variation in private benefits, firms with larger private benefits would be more inclined to engage in defensive acquisitions. Moreover, we conjecture that unprofitable acquisitions would be even more attractive to managers since the higher private benefits that can be obtained in larger firms would give them another reason to make acquisitions in their own interests at the expense of their shareholders. Our assumption of homogenous private benefits allows us to spell out the consequences of one particular managerial motive—survival of the firm as an independent entity—while abstracting from other motives such as general empire-building tendencies that are already well understood in the literature (Baumol (1959), Marris (1964), Jensen (1986, 1993)).

cannot fully overcome the managerial preference for their firms to remain independent.[14]

We assume that at each date, a firm can make at most one acquisition offer to another firm. Within each period, Firm 1 moves first and Firm 2 moves second (Firm 3 cannot make an acquisition). The profitability of a merger depends on the identities of the merger partners and on the state of nature, realized at date 1. Each firm can make at most one acquisition over the two dates: If it has made an acquisition at date 0, it cannot make another one at date 1. This assumption simplifies the analysis and is discussed in more detail in Section IV below.

At the start of date 0 firms learn that a regime shift has occurred. The regime shift makes future efficient mergers possible. For example, a fundamental change in technology or government regulation may at some point in the (near) future make acquisitions profitable, perhaps due to economies of scale. The key is that the regime shift changes conditions in the industry enough to make some acquisitions possibly profitable, but the probability of acquisitions becoming profitable is low enough such that current acquisitions are not yet profitable for the acquirer.

More concretely, we assume that mergers are *possibly* efficient, depending on the state of nature at date 1. Specifically, firms learn at date 0 that the state of nature at date 1 will be good with probability ρ and bad with probability $1-\rho$, but they do not learn at date 0 whether the state will be good or bad at date 1. They learn the realization of the state (whether it is good or bad) at date 1. In the good state of nature, only mergers involving Firm 1 (whether undertaken at date 0 or date 1) are efficient in the sense that if Firm 2 or Firm 3 is combined with Firm 1, it is worth more than its stand-alone value of C_2 or C_3, respectively. For simplicity, we assume that Firm 2 and Firm 3 are worth twice as much when combined with Firm 1 than as stand-alones: Firm 2 (3) is worth $C_2(C_3)$ as a stand-alone, but is worth $2C_2$ ($2C_3$) if combined with Firm 1. However, if Firm 2 combines with Firm 3, there are no synergies: Their combined value is equal to the sum of their stand-alone values $C_2 + C_3$. Assuming that a combination of Firms 2 and 3 would create value would not change the main results.[15]

In the bad state at date 1, all mergers (whether undertaken at date 0 or date 1) destroy value. For simplicity, we assume that any target acquired by another firm is worth zero in the bad state at date 1. Again, this is just a normalization, and it could easily be adjusted without affecting the qualitative results of our analysis.

To make the merger decision interesting, we want mergers to be unprofitable (value-reducing), at date 0 even for Firm 1. This is the case if the bad state is more likely than the good state:

[14] An assumption that the agency conflict cannot be fully eliminated through compensation contracts is typically made in the literature (see, for example, Hart and Moore (1995)).

[15] We have verified that the equilibrium merger dynamics would be very similar if the value of Firm 3 doubled when combined with Firm 2 in the good state at date 1. The only difference would be that the cut-off level of private benefits above which Firm 2 acquires Firm 3 at date 0 would be lower, because the date 0 acquisition is now less unprofitable.

$$\rho < 0.5. \tag{1}$$

Firms might make unprofitable acquisitions in our model because we assume that the acquiring firms' *managers* decide whether or not to make an offer. We assume that the *shareholders* of the target firm make the decision about whether to accept an offer.[16] They will not accept an offer that does not give them at least a zero premium over the firm's stand-alone value. We discuss the determination of the premium below.

Finally, we determine the price at which a firm can acquire another firm by applying the Nash bargaining solution to a bargaining game (or "bargaining problem") between the acquiring firm's manager and the target firm's shareholders. We ignore the target firm's manager in the bargaining since we assume that target shareholders, not the manager, accept or reject a takeover offer. Of course, if the target firm's manager could prevent a takeover, there would be no incentives to make defensive acquisitions. Similarly, we ignore the acquiring firm's shareholders in the bargaining problem, since we assume that it is the acquiring firm's manager, not the shareholders, who makes takeover decisions. This allows us to analyze how managerial motives affect acquisition decisions, which is one of our key objectives. If the acquiring firm's shareholders made acquisition decisions or otherwise could prevent a merger that is not in their interests, there would be no unprofitable acquisitions since managerial motives would not affect acquisition decisions.

To obtain the bargaining outcome, we apply the Nash bargaining solution to our bargaining problem. The bargaining problem is fully specified by the set of possible utility pairs that the parties can obtain through agreement and the disagreement point (the utility pair of the parties if there is no agreement). The utility of the acquirer's manager is $u_A = \tilde{w} + \alpha(\tilde{s} - \pi)$, where $\tilde{w}$ is the expected value of the private benefits the manager gets (as of the date the acquisition occurs), $\tilde{s}$ is the expected value of the increase in the acquiring firm's value due to the acquisition (which includes the increase in the value of the target firm through synergies), and π is the premium over the target firm's stand-alone value that the acquirer's manager and the target shareholders agree

[16] A central idea behind our model is that takeovers can serve a defensive purpose in that an acquisition reduces the probability of being acquired. Hence, defensive acquisitions can be viewed as takeover defenses. Our model ignores other takeover defenses such as poison pills and staggered boards. To the extent that these other takeover defenses can be employed, they may substitute for defensive acquisitions and hence make defensive acquisitions less relevant. We agree that other takeover defenses can be important and effective (see, for example, Bebchuk, Coates, and Subramanian (2002)). In the literature, the effectiveness of takeover defenses is still being debated. For example, Ambrose and Megginson (1992) find that the only common takeover defense that is significantly negatively correlated with acquisition likelihood are blank-check preferred stock authorizations. Comment and Schwert (1995) conclude that "poison pill rights issues, control share laws, and business combination laws have not systematically deterred takeovers and are unlikely to have caused the demise of the 1980s market for corporate control . . . Antitakeover measures increase the bargaining position of target firms, but they do not prevent many transactions." (p. 3). See also Jensen and Ruback (1983), Jarrell, Brickley, and Netter (1988), and Ruback (1988) for earlier surveys of the evidence on takeover defenses. Also see Schwert (2000).

on.[17] The utility of the target's shareholders is $u_B = \pi$. Solving u_A for π, one obtains: $\pi = \tilde{w}/\alpha + \tilde{s} - u_A/\alpha = h(u_A) = u_B$. The Nash bargaining solution is characterized by the condition $-h'(u_A) = (u_B - d_B)/(u_A - d_A)$, where $h(u_A) = u_B$ (see Muthoo (1999), Proposition 2.3, p. 24), and where d_A is the utility from disagreement for the manager of the acquirer and d_B is the utility from disagreement for the target firm's shareholders (i.e., (d_A, d_B) is the disagreement point). We assume that $d_B = 0$, which means that the target shareholders' disagreement point is a zero premium.[18] Applying the above condition characterizing the Nash bargaining solution, one obtains $1/\alpha = ((\tilde{w}/\alpha) + \tilde{s} - (u_A/\alpha))/(u_A - d_A)$. Solving this equation for u_A, one obtains $u_A = 0.5\tilde{w} + 0.5\alpha\tilde{s} + 0.5d_A$, that is, the acquiring firm's manager obtains one-half of his utility if the acquisition occurs at a zero premium $(\tilde{w} + \alpha\tilde{s})$ plus one half of his utility from disagreement (his utility if he does not make the acquisition, d_A). This implies a premium of $\pi = (0.5/\alpha)(\tilde{w} + \alpha\tilde{s} - d_A)$. The expression in the second set of brackets is the difference between the utility that the acquiring firm's manager obtains if the acquisition occurs at a zero premium and his utility from disagreement.

For example, if Firm 1 acquires Firm 2 in the good state at date 1, Firm 1's manager obtains a utility of w if he does not make the acquisition. If he makes the acquisition at a zero premium, he obtains $w + \alpha C_2$. Hence, the premium is $\pi = (0.5/\alpha)(w + \alpha C_2 - w) = 0.5C_2$. Note that the disagreement point for the acquiring firm's manager depends on the future (optimal) merger activity if there are additional mergers. For example, if Firm 2 acquires Firm 3 at date 0, the premium it pays over Firm 3's stand-alone value, C_3, reflects that in the absence of this acquisition, Firm 2 is acquired by Firm 1 later on.

In our model, the private benefits explicitly affect the premium. The premium the manager pays reflects the effect of the acquisition on his private benefits. This implies that acquirers may pay a positive premium even though there are no (or even negative) synergies between acquirer and target. Indeed, such mergers without positive synergies could not occur if the premium did not reflect to some extent the private benefits gained by the acquiring firm's manager. Otherwise, the premium would have to be negative, and that would not be accepted by the target's shareholders. Hence, the target extracts some of the acquiring manager's private benefits from the acquisition, via the premium. More generally, unprofitable acquisitions (even if there are positive synergies) can occur only if the acquiring firm's manager pays a premium higher than

[17] In formulating the manager's utility function, we ignore the manager's share of the firm's stand-alone value. Including it would not change anything, since it is unaffected by the acquisition decisions. The increase in the value of the acquiring firm also includes future takeover premia earned by the combined firm in the models in Sections II and III.

[18] This assumption simplifies the analysis considerably, because we do not have to consider how gains or losses as well as takeover premia in possible future acquisitions involving the target as acquirer or target after disagreement is reached affect the conditions under which a firm acquires another firm. In the basic model, relaxing this assumption makes no difference, because the target never has another merger opportunity. We have verified for the four-firm model below in Section II that the equilibrium merger activity remains the same if we relax this assumption. We conjecture that our main results are robust to relaxing this assumption also in the other models below, but have not formally verified this, because the calculations are very cumbersome.

the synergies and hence shares some of the private benefits he gains with the target firm's shareholders.[19]

The exact split of the surplus from a merger between the manager of the acquiring firm and the target shareholders is not important for our results. We have verified for the basic model (as well as the five-firm model below in Section I.D and the four-firm model below in Section II) that if the surplus from the merger is split such that the acquirer's manager keeps a fraction ε and not one-half (as implied by the Nash bargaining solution), for any $\varepsilon \in (0, 1)$, our results are qualitatively similar although the exact conditions on the private benefits w below or above which certain mergers occur change.[20] In fact, our model with $\varepsilon = 0.5$ is a special case of this more general model. In our model, acquisitions occur if and only if the acquiring firm's manager benefits from them if he pays a zero premium. The exact split of the surplus is not important for the equilibrium merger dynamics.

B. Equilibrium Merger Activity

To find the equilibrium pattern of mergers, we solve the model by backward induction, starting at date 1.[21] Firm 2 moves last (since Firm 3 cannot make an acquisition). If the realized state of nature at date 1 is bad, all acquisitions are unprofitable. Firm 2 does not acquire Firm 3 since then Firm 3 is worth zero but Firm 2 has to pay at least the stand-alone value of the target firm. Moreover, Firm 2 does not need to defend itself against a potential acquisition, because Firm 1 does not have an opportunity to acquire it anymore. Firm 1 does not acquire Firm 2 or Firm 3 since the acquisition is unprofitable and Firm 1, being the largest firm, does not need to defend itself against a potential acquisition.

If the state at date 1 is good, Firm 2 does not acquire Firm 3, because this merger creates zero synergies and Firm 2 has to pay at least Firm 3's stand-alone value. Moreover, Firm 2 does not have any defensive motives at this point, because Firm 1 cannot make an acquisition anymore. Firm 1 moves before Firm 2 and wants to acquire the largest remaining firm, because its gains from the merger are increasing in the size of the target. If Firm 2 has not acquired Firm 3 before, Firm 1 acquires Firm 2 and pays a premium of $0.5C_2$, as explained above. Firm 2, because it is acquired by Firm 1, does not get to make an acquisition offer.

[19] An alternative modeling approach would require an exogenous premium that is a (nonnegative) constant fraction of the stand-alone value of the target. Then, managers may also engage in unprofitable acquisitions (with the premium exceeding synergies) to preserve their private benefits. We have verified for the basic model that the merger dynamics would be very similar in this case. We have also verified this for the four-firm model below in Section II. We conjecture that the main results would also be the same for the two five-firm models below.

[20] We conjecture that the main results in the five-firm model in Section III below are also unchanged if one varies the split of the surplus.

[21] The unique subgame perfect equilibrium is the equilibrium associated with the backward induction outcome, because our model is a game of complete and perfect information.

Now let us turn to date 0. Firm 2 moves last and can acquire Firm 3. This acquisition is unprofitable (i.e., the acquirer's postacquisition value is below its stand-alone value) and hence reduces shareholder value, because it has negative expected synergies but involves a positive premium. However, Firm 2's manager still may want to acquire Firm 3 since this ensures that he keeps his private benefits in the good state at date 1. If Firm 2 acquires Firm 3 at date 0 and pays a zero premium, the expected utility of Firm 2's manager is $2w - \alpha(1-\rho)C_3$. The manager is employed in both dates, and hence he gets total private benefits of $2w$. The merger with Firm 3 generates no synergies in the good state at date 1, but destroys C_3 in value in the bad state. Since the manager owns a share α of Firm 2 and the bad state occurs with probability $1-\rho$, the manager has an expected utility loss of $\alpha(1-\rho)C_3$. On the other hand, if Firm 2 does not acquire Firm 3 at date 0, it is acquired by Firm 1 in the good state at date 1, as seen above. Hence, the expected payoff of Firm 2's manager if he does not acquire Firm 3 at date 0 is $w + (1-\rho)w + \rho 0.5\alpha C_2$, equal to the private benefits at date 0 and in the bad state at date 1 plus the premium paid to the manager as a part owner of the firm when it is acquired by Firm 1 in the good state at date 1. As a consequence, the manager of Firm 2 chooses to acquire Firm 3 at date 0 if and only if $2w - \alpha(1-\rho)C_3 > w + (1-\rho)w + \rho 0.5\alpha C_2$, that is:[22]

$$w > 0.5\alpha C_2 + \alpha\frac{1-\rho}{\rho}C_3. \tag{2}$$

Firm 1 never acquires another firm at date 0. Such an acquisition is unprofitable.[23] Proposition 1 summarizes the above discussion.

PROPOSITION 1: *If (2) does not hold, Firm 1 acquires Firm 2 in the good state at date 1 in a profitable acquisition. If (2) holds, Firm 2 acquires Firm 3 at date 0 in an unprofitable acquisition.*

Hence, for low private benefits, there is only the profitable (positive NPV) acquisition of Firm 2 by Firm 1. For high private benefits, Firm 2 acquires Firm 3 in an unprofitable (negative NPV) acquisition at date 0.

As can be seen from condition (2), for a given level of private benefits, the condition under which Firm 2 acquires Firm 3 is less likely to be satisfied if α is larger, because then Firm 2's manager cares more about firm value. Moreover, if the probability of the good state at date 1 is higher, the minimal

[22] Firm 2 pays $C_3 + (0.5/\alpha)(2w - \alpha(1-\rho)C_3 - (w + (1-\rho)w + \rho 0.5\alpha C_2))$ for Firm 3, because the disagreement point of Firm 2's manager is his utility if Firm 2 does not acquire Firm 3 but instead Firm 2 is acquired by Firm 1 in the good state at date 1.

[23] Note also that there is no incentive for Firm 1 to acquire any other firm in order to improve its acquisition opportunities at date 1 since we have assumed that each firm can make only one acquisition. For example, Firm 1 may want to acquire Firm 3 at date 0 although this is unprofitable because it ensures that Firm 2 is available as a target at date 1. However, because Firm 1 can only acquire one firm, it is never interested in acquiring Firm 3 at date 0 in order to make sure that it can acquire Firm 2 at date 1. The simplifying assumption that each firm can make only one acquisition is considered in more detail in Section IV, where we discuss relaxing this assumption.

private benefits that induce the manager to engage in the date 0 acquisition are smaller. This implies that defensive mergers are more likely after a regime shift that increases the likelihood that future mergers are efficient. This is because a date 0 acquisition becomes more attractive if the probability that such an acquisition turns out to not destroy value increases. In addition, if the probability of the good state is higher, there is a greater chance that Firm 2 is acquired by Firm 1 if Firm 2 does not acquire Firm 3 at date 0. Firm 2's manager acquires Firm 3 at date 0 to avoid this.

As this discussion illustrates, condition (2), which determines the equilibrium merger dynamics, depends on several parameters. Below, we often refer to this condition (and similar conditions for the models in the other sections) in our discussions and tables as a condition on private benefits. It should be understood that the other parameters entering the conditions, such as managerial ownership, the likelihood of the good state, and the stand-alone values of the firms, are equally important and determine the value of private benefits above or below which certain mergers occur. We focus on private benefits only for convenience, because it would be too cumbersome to always refer to all key parameters.

Proposition 1 also shows that if managers care about private benefits, there are more mergers (one) than are expected in the first-best world with no managerial merger motives (ρ). This is because managers do not acquire just when their firms are otherwise certain to be acquired, but also when there is a significant chance that their firms will be acquired in the future.

C. A Preview of the Results from the Models in the Remainder of the Paper

The basic model illustrates that firms may engage in defensive acquisitions to preserve their independence and their managers' private benefits. This defensive motive arises because the firms are of similar size. Hence, Firm 2 can become larger than Firm 1 by acquiring Firm 3. The remainder of the paper analyzes several other models and shows that the initial firm size distribution is an important determinant of merger dynamics and the value creation in acquisitions. In this section, we preview the remaining part of the paper informally and provide a road map for the rest of the paper. The key features of the models in the rest of the paper and their results are summarized in Table I. The timing of events in these additional models is summarized in Figures 1b, 1c, and 1d.

The basic model has only three firms, and hence there could be only at most one merger. Section I.D extends the model to five firms (see Figure 1b) to allow for the possibility of two mergers, which we refer to as a "merger wave." We still assume that all firms are of similar size. In particular, even the smallest two firms combined are larger than the largest firm. As a consequence, defensive merger motives may be important. As in the basic model, if private benefits are low enough, there is only the profitable acquisition of the second-largest firm by the largest firm in the good state at date 1. But if private benefits are high enough, unprofitable defensive acquisitions occur. By using five firms, we are able to show that defensive mergers can come in waves. In the five-firm

Table I
Overview of Models and Results

Model	Paper Section	Number of Firms	Industry Structure (C is firm value; $C_i > C_j$ for $i < j$)	Merger Activity: Low Private Benefits	Merger Activity: High Private Benefits (PB)	Merger Activity: Defensive or Positioning Acquisitions?
Basic model	I.A, I.B	3	$C_2 + C_3 > C_1$	1 acquires 2 in the good state at date 1; profitable (Prop. 1)	2 acquires 3 at date 0; unprofitable (Prop. 1)	Defensive acquisition if PB high
Firms of similar size	I.D	5	$C_4 + C_5 > C_1$	1 acquires 2 in the good state at date 1; profitable (Prop. 2)	4 acquires 5 and 2 acquires 3 either at date 0 or in the good state at date 1; both unprofitable (Prop. 2)	Defensive acquisitions if PB high
Dominant firm	II	4	$C_1 > C_2 + C_3$ and $C_3 + C_4 > C_2$	2 acquires 4 at date 0; 1 acquires (2 + 4) in the good state at date 1; both acquisitions profitable (Prop. 3)	1 acquires 2 in the good state at date 1; profitable (Prop. 3)	Positioning acquisition if PB low
Some, but not all firms of similar size	III	5	$C_2 + C_5 > C_1$; $C_3 + C_4 > C_1$; $C_3 + C_5 < C_1$; $C_4 + C_5 > C_2$	4 or 3 acquires 5 at date 0 or in the good state at date 1; then 1 acquires (3 + 5) or (4 + 5) in the good state at date 1; all acquisitions profitable (Prop. 4)	2 acquires 5 either at date 0 or in the good state at date 1 and 3 acquires 4 in the good state at date 1; both acquisitions unprofitable. If PB very high, 4 acquires 5 at date 0; unprofitable. Then 1 acquires (4 + 5) in the good state at date 1; profitable (Prop. 4)	2 makes defensive acquisition; 4 makes positioning acquisition (except for very high PB). 3 makes sometimes positioning acquisition and sometimes defensive acquisition

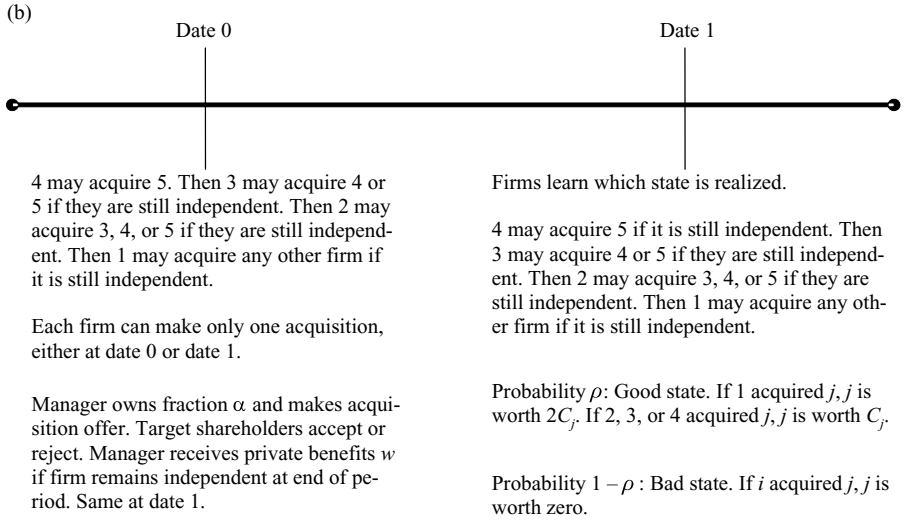

Figure 1b. Timeline for five-firm model in Section I.D.

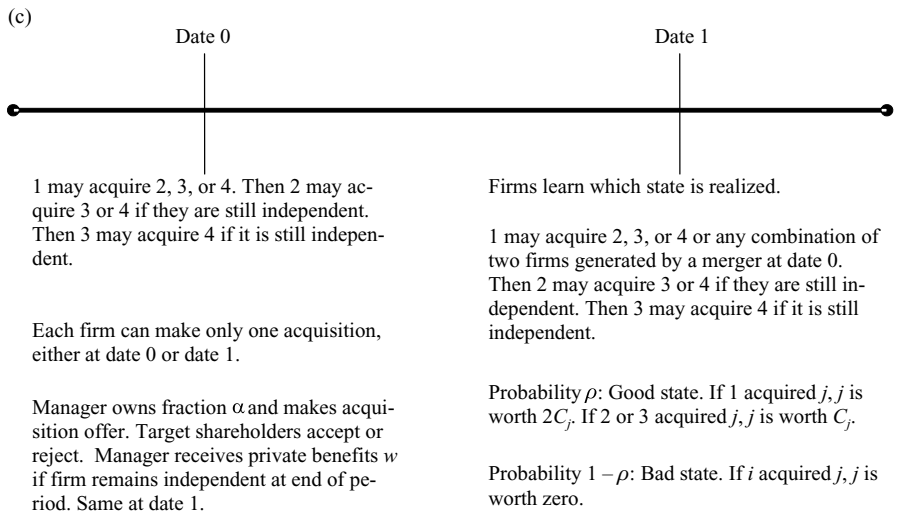

Figure 1c. Timeline for four-firm model in Section II.

model, this means that there are two defensive mergers. Firm 4 acquires Firm 5 and then Firm 2 acquires Firm 3. The intuition is that defensive mergers impose externalities on other firms. What matters for the probability of being acquired (and losing one's private benefits) is the firm's size relative to other firms. If other firms become larger through acquisitions, a firm becomes more vulnerable to being acquired and hence has an incentive to become larger itself. Hence, a race for firm size ensues. This gives rise to defensive merger waves.

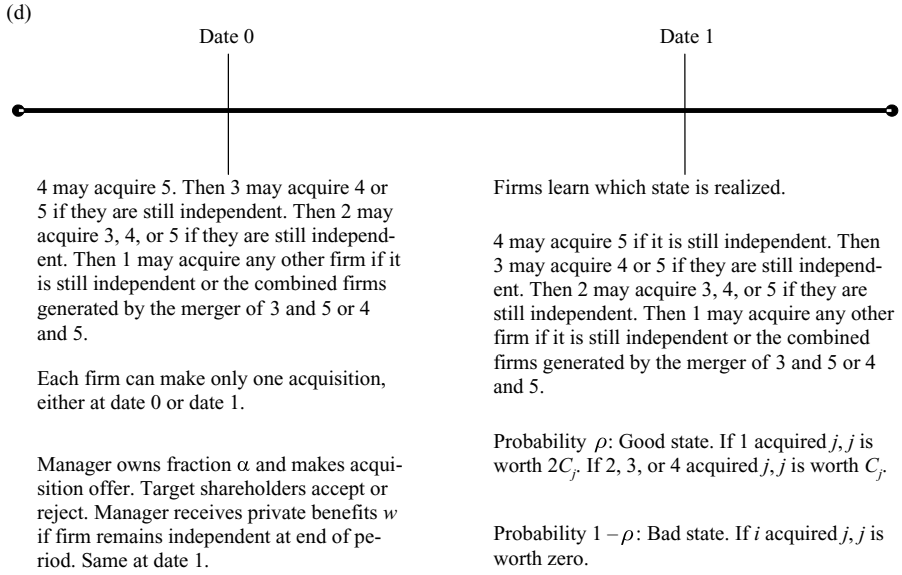

Figure 1d. Timeline for five-firm model in Section III.

Different firm size distributions can give rise to very different merger dynamics. Section II analyzes an industry with four firms with a dominant firm that is much larger than the other firms (see Figure 1c). In particular, Firm 1 is larger than the combination of Firms 2 and 3. We show that in such an industry, there are no defensive acquisitions. Even the second-largest firm cannot become the largest firm in the industry (and hence become immune against being acquired) by making an acquisition. However, in such an industry there is another merger motive, which we call "positioning," if Firm 3 can become larger than Firm 2 by acquiring Firm 4. Firms may want to acquire other firms to become larger and hence (in our setting where synergies increase in size) more attractive acquisition targets for the largest firm. We show that if managers care sufficiently about firm value (if private benefits are low enough), there is a positioning acquisition. Firm 2 acquires Firm 4 to ensure that it remains the second-largest firm (otherwise Firm 3 would acquire Firm 4 and become larger than Firm 2) and hence is the preferred target for Firm 1. However, if private benefits are high enough, there is no positioning acquisition and Firm 1 acquires Firm 2 in the good state at date 1.

Of course, firms of similar and of very different size relative to the largest firm can coexist, unlike in the models discussed so far. Section III analyzes the merger dynamics in an industry with five firms in which some firms are of similar but others of very different size (see Figure 1d). Importantly, there is also a "medium-size" firm (Firm 3), which can become the largest firm in

the industry (by acquiring Firm 4), but can also make a small acquisition (of Firm 5), which makes it the second-largest firm and hence the most attractive takeover target. We show that if private benefits are low enough, either Firm 3 or Firm 4 acquires Firm 5 after which the combined entity is acquired by Firm 1 in the good state at date 1. All these positioning acquisitions are profitable. However, if private benefits are high enough, there are two defensive mergers: Firm 3 acquires Firm 4 and Firm 2 acquires Firm 5, both to avoid becoming targets themselves.[24] In this setting, there are two mergers (and hence a merger wave) for low as well as high private benefits. Moreover, this model shows that firm size is important for merger motives. Large firms make only defensive (and hence unprofitable) acquisitions. Small firms make only positioning (and hence profitable) acquisitions.[25] Medium-sized firms make small and profitable positioning acquisitions if private benefits are low but large and unprofitable defensive acquisitions if private benefits are high.

D. Defensive Merger Waves

In this section, we show how defensive motivations can lead to merger waves, where we define a merger wave as an equilibrium with more than one merger. For this, we expand the basic model in the previous section to five firms. The sequence of events is given in Figure 1b. Table I summarizes the industry structure and the results for this case. Merger synergies are similar to those in the three-firm model. If Firm j is combined with Firm 1, its value is $2C_j$ in the good state at date 1, while all other combinations lead to neither positive nor negative synergies. We assume that only one firm has profitable acquisition opportunities (arising from positive synergies) to show that even if this is the case, our model can generate more than one merger. We assume that Firm 1 is the firm with the profitable acquisition opportunity. This generates defensive merger motives for all other firms.[26] As before, we assume that any firm that is acquired is worth zero in the bad state at date 1.

We assume that all firms are sufficiently close in size such that the acquisition of any other firm makes each firm larger than Firm 1: $C_4 + C_5 > C_1$. We refer to this industry as a homogenous firm size industry. Moreover, each firm can make only one acquisition. Our assumptions imply that an efficient merger occurs with probability ρ and the maximum number of mergers is two. Further, we assume that if a firm is indifferent between acquiring two firms, it resolves this indifference in favor of acquiring the smaller of the two firms. Finally, we assume that within each period, Firm 4 moves first, Firm 3 second, Firm 2 third, and Firm 1 last (Firm 5 cannot make an acquisition). We reverse the

[24] If private benefits are very high, Firm 4 acquires Firm 5 in an unprofitable, defensive acquisition that preserves its independence at date 0 and in the bad state at date 1.

[25] There is one exception for very high private benefits, as explained in the previous footnote.

[26] Since firms that are larger than the largest firm with a profitable acquisition opportunity never participate in any merger, we can ignore such firms. In that sense, giving Firm 1 the profitable acquisition opportunity is without loss of generality.

order of moves relative to the three-firm model in the previous section because this makes the intuition behind the merger dynamics richer. However, if we assumed the opposite (original) order of moves, we would get similar results, and in particular, we would also get a defensive merger wave.

Proposition 2 summarizes the merger activity for all parameter regions. Its proof as well as the proofs of all subsequent propositions can be found in the Appendix. The following condition plays an important role:

$$w \leq 0.5\alpha C_2. \tag{3}$$

PROPOSITION 2: *If (3) holds, Firm 1 acquires Firm 2 in the good state at date 1. This acquisition is profitable. If (3) does not hold, Firm 4 acquires Firm 5 and Firm 2 acquires Firm 3. Both acquisitions are unprofitable. The date of the mergers depends on private benefit levels. For intermediate values of private benefits Firm 4 acquires Firm 5 at date 0 or in the good state at date 1 and Firm 2 acquires Firm 3 in the good state at date 1. For high values of private benefits, both of these acquisitions occur at date 0.*

The proposition shows that if private benefits are low enough, the only merger is the most efficient one between Firm 1 and Firm 2. However, if managers care enough about their private benefits so that (3) is not satisfied, the merger dynamics are drastically transformed from a world with only one profitable acquisition into a world with two defensive, unprofitable acquisitions that preempt the efficient and profitable acquisition. When this happens, our model gives rise to a merger wave—two mergers either both at date 0, both at date 1, or one merger each at date 0 and date 1. Note that here and in the following, when we refer to the number of mergers at date 1, we mean the number of mergers in the good state at date 1. As we have shown, there are no mergers in the bad state at date 1.

The intuition behind the merger dynamics is as follows. Consider the situation when Firm 4 acquires Firm 5 at date 0. Firm 4 acquires Firm 5 at date 0, because otherwise Firm 3 would acquire Firm 5, since it knows that otherwise Firm 2 would acquire Firm 5 to avoid being the largest remaining firm and hence the most attractive target for Firm 1. Firm 2 would acquire Firm 5 at date 0, because it anticipates that otherwise Firm 4 would acquire Firm 5 in the good state at date 1, anticipating that otherwise Firm 3 or Firm 2 would do so.[27] Given the order of moves, Firm 4 acquires Firm 5 at date 0. After that acquisition, Firm 2 can only secure its independence by acquiring Firm 3.

We also see from Proposition 2 that the mergers tend to occur earlier if private benefits are higher. In our model, date 0 mergers mean that the synergies are

[27] If it did not acquire Firm 5 at date 0 and Firm 4 acquired Firm 5 in the good state at date 1, Firm 2 could still acquire Firm 3 in the good state at date 1, but that turns out to be less attractive than acquiring Firm 5 at date 0. Similarly, if Firm 3 did not acquire Firm 5 at date 0, it could still acquire Firm 4 in the good state at date 1 after Firm 2 acquires Firm 5 at date 0, but this turns out to be less attractive.

lower.[28] However, early acquisitions (at date 0) can be less unprofitable for the acquirer than late (date 1) acquisitions.[29]

II. An Industry with a Dominant Firm: Positioning Mergers

In the previous section we analyze the merger dynamics in a situation in which all firms were of similar size. We show that in such an industry, defensive mergers are likely. In this section, we turn to a very different industry structure—one in which the largest firm is much larger than all the other firms. We show that in such an industry, the merger dynamics are very different. In particular, firms may undertake an acquisition to become more attractive targets for other firms. We call these positioning mergers. Again, we present the simplest model that generates the basic insights. For this purpose, a model with four firms suffices. Figure 1c shows the sequence of events. Table I summarizes the industry structure and the results for this case.

A. The Model

Assume that there are four firms, with Firm 1 much larger than the other firms. In particular, let $C_1 > C_2 + C_3$. The other three firms are of similar size so that Firm 3 and Firm 4 are, if combined, larger than Firm 2: $C_3 + C_4 > C_2$. We refer to this industry as one with heterogeneous firm size. At each date, Firm 1 moves first, Firm 2 second, and Firm 3 last (since Firm 4 cannot make an acquisition). Merger synergies are as in the previous two models, with only acquisitions by Firm 1 having positive synergies in the good state

[28] Even after Firm 4 has acquired Firm 5 at date 0, Firm 2 prefers acquiring Firm 3 at date 0 rather than at date 1 for high enough private benefits. The reason is that if Firm 2 acquires Firm 3 at date 1, this is its last chance to secure its independence. Firm 3 understands that and extracts part of the private benefits for itself in the form of a high takeover premium. If Firm 2 acquires Firm 3 at date 0, the only surplus that Firm 3 can extract partially from Firm 2 is the difference between the utility of Firm 2's manager if he acquires Firm 3 at date 0 and his utility if he acquires Firm 3 in the good state at date 1. Since both acquisitions secure Firm 2's independence, Firm 3 cannot extract the private benefits in a date 0 acquisition.

[29] The profitability of an acquisition is calculated as the change in the acquirer's value arising from the acquisition (postacquisition value minus stand-alone value) divided by the acquirer's stand-alone value. For example, if Firm 4 acquires Firm 5 at date 0 and then Firm 2 acquires Firm 3 in the good state at date 1, the first acquisition can be more or less unprofitable than the second. The synergies are lower (because negative) in the first merger, which tends to decrease the profitability of the acquisition. However, Firm 2 may pay a higher premium in the date 1 acquisition than Firm 4 in the date 0 acquisition, and hence the early acquisition can be less unprofitable. The premium Firm 2 pays can be higher, because it partially transfers its manager's utility gain from staying in control for sure (since the acquisition ensures he will stay in control) to Firm 3. In contrast, the date 0 acquisition of Firm 5 by Firm 4 transfers partially the utility gain of Firm 4's manager from staying in control with only the probability that the good state arises (since in the bad state at date 1 he stays in control even without the acquisition). Hence, for high enough private benefits and low enough probability of the good state arising, the premium in the date 1 acquisition is sufficiently higher to outweigh the higher (not negative) synergies.

at date 1 and all mergers having negative synergies in the bad state at date 1.[30]

B. Analysis

As in the previous section, we solve the model by backward induction. In the bad state at date 1, there is no acquisition. In the good state at date 1, Firm 3 and Firm 2 remain passive. Firm 1 acquires the largest remaining firm. If no acquisition has occurred yet, Firm 1 acquires Firm 2.

Now we turn to date 0. The last firm to move at that date is Firm 3. If Firm 3 acquires Firm 4, it becomes the second-largest firm, since we have assumed $C_3 + C_4 > C_2$. Acquiring Firm 4 makes Firm 3 the most attractive target for Firm 1, which acquires the combination of Firms 3 and 4 in the good state at date 1. Firm 1 pays a price of $C_3 + C_4 + 0.5(C_3 + C_4)$ for the combined firm. Hence, Firm 3's manager receives an expected payoff at date 0 of $w + (1 - \rho)(w - \alpha C_4) + \rho\alpha 0.5(C_3 + C_4)$ if Firm 3 acquires Firm 4 at a zero premium. If Firm 3 does not acquire Firm 4, Firm 2 remains the second-largest firm and hence Firm 1 acquires Firm 2 in the good state at date 1. As a consequence, Firm 3's manager receives a payoff of $2w$. Hence, Firm 3 acquires Firm 4 if and only if $w + (1 - \rho)(w - \alpha C_4) + \rho\alpha 0.5(C_3 + C_4) > 2w$, that is:

$$w < 0.5\alpha(C_3 + C_4) - \alpha\frac{1 - \rho}{\rho}C_4. \tag{4}$$

Firm 2 moves before Firm 3 at date 0. If Firm 2 acquires Firm 4 at date 0, it ensures that it remains the second-largest firm and is acquired by Firm 1 in the good state at date 1. Firm 1 pays a price of $C_2 + C_4 + 0.5(C_2 + C_4)$ for the combined firm. Hence, Firm 2's manager receives an expected payoff at date 0 of up to $w + (1 - \rho)(w - \alpha C_4) + \rho\alpha 0.5(C_2 + C_4)$ if Firm 2 acquires Firm 4. If Firm 2 does not acquire Firm 4, two situations can arise. If (4) holds, Firm 3 acquires Firm 4, making it the second-largest firm. In this case, Firm 1 acquires the combination of Firms 3 and 4 and Firm 2 remains independent. Hence, Firm 2's manager receives a payoff of $2w$. As a consequence, Firm 2 acquires Firm 4 if and only if $w + (1 - \rho)(w - \alpha C_4) + \rho\alpha 0.5(C_2 + C_4) > 2w$. One can easily show that this implies that Firm 2 acquires Firm 4 whenever (4) holds.

If (4) does not hold, Firm 3 remains passive and does not acquire Firm 4 when Firm 2 has not acquired Firm 4. In this case, Firm 2 continues to be the second-largest firm and is acquired by Firm 1 for a price of $C_2 + 0.5C_2$ in the good state at date 1. Hence, Firm 2's manager receives an expected payoff at date 0 of $w + (1 - \rho)w + \rho\alpha 0.5C_2$. Given this, one can easily calculate that Firm 2

[30] We have verified that the equilibrium merger dynamics would be very similar if the target firm in an acquisition would be worth twice its stand-alone value in the good state at date 1 regardless of which firm is the acquirer (and hence also if the acquirer is Firm 2 or Firm 3). The only differences would be that the cut-off value for private benefits below which Firm 2 acquires Firm 4 at date 0 would be different and that Firm 3 would acquire Firm 4 after Firm 1 acquires Firm 2 in the good state at date 1 for high enough private benefits.

never acquires Firm 4 if (4) does not hold. Hence, Firm 2 acquires Firm 4 if and only if (4) holds. One can also show that Firm 2 always prefers to acquire Firm 4 to acquiring Firm 3. Proposition 3 summarizes the equilibrium merger dynamics.

PROPOSITION 3: *If (4) holds, Firm 2 acquires Firm 4 at date 0. Then Firm 1 acquires the combination of Firm 2 and Firm 4 in the good state at date 1. Both acquisitions are profitable. If (4) does not hold, Firm 1 acquires Firm 2 in the good state at date 1. This acquisition is also profitable.*

In contrast to the previous models, the relationship between private benefits and the number of mergers is reversed. In particular, there are two mergers if private benefits are *low* enough and there is only one merger if private benefits are sufficiently high. The early acquisition of Firm 4 by Firm 2 is *not* defensive. Quite to the contrary, Firm 2 acquires Firm 4 to ensure that it remains the most attractive target—because it is the largest potential target firm—for Firm 1 in the good state at date 1. If it would not acquire Firm 4, Firm 3 would do so and become the second-largest firm and hence the most attractive takeover target for Firm 1. Managers engage in these positioning acquisitions to make their firms more attractive targets only if they care sufficiently about firm value and less about the private benefits of control. This explains why they engage in acquisitions if private benefits are low (or managerial ownership is high) but avoid acquisitions if private benefits are high.

It should be noted that the date 0 acquisition of Firm 4 by Firm 2—in contrast to the date 0 acquisitions in the previous models—is a positive NPV acquisition for Firm 2. Firm 2 engages in this acquisition only if the expected takeover premium it can earn $(0.5\rho(C_2 + C_4))$ is worth more than the expected loss in firm value that arises due to the negative synergies in the bad state of nature $((1-\rho)C_4)$ and the premium that it has to pay to acquire Firm 4. This is implied by condition (4), as can be seen after some algebraic transformation.[31]

III. An Industry in Which Some but Not All Firms Are of Similar Size

In Section I, we present two models that analyze homogenous firm size industries and introduce defensive mergers, which are prominent in such industries. In Section II, we analyze heterogeneous firm size industries where positioning mergers are important. In this section, we present a model in which some firms are close in size to the largest firm, but others much smaller. Table I summarizes the industry structure and results for this case. The sequence of events is summarized in Figure 1d. We refer to this type of industry as a mixed firm

[31] As in the previous model, it is not clear whether date 0 or date 1 acquisitions are more profitable. If Firm 2 acquires Firm 4 at date 0 and then Firm 1 acquires the combination of Firms 2 and 4 in the good state at date 1, either of the two acquisitions can be more profitable. The early acquisition (of Firm 4 by Firm 2) can be more profitable in particular if private benefits are fairly high (because the premium Firm 2 pays for Firm 4 decreases in the level of private benefits) and the good state of nature is sufficiently likely.

size industry. We show that in such an industry both defensive and positioning mergers can occur. The mixed firm size industry is arguably the richest industry structure. It allows us to derive a number of additional results (for example, on the identity of acquirers and targets) and derive others in a cleaner fashion (such as the relationship between acquirer size, deal size, and the profitability of acquisitions). However, the previous models in Sections I and II are not special cases of this model. There we derived equilibrium merger dynamics in industry structures that are not covered by the model in this section. Indeed, one of the primary insights arising from our analysis is that industry structure matters for merger dynamics.

At each date, Firm 4 moves first, Firm 3 second, Firm 2 third, and Firm 1 last. We assume that $C_2 + C_5 > C_1$, $C_3 + C_4 > C_1$, $C_3 + C_5 < C_1$, and $C_4 + C_5 > C_2$. Hence, Firm 2 is large enough that any acquisition makes it larger than Firm 1 and hence immune against any acquisition. Below, we refer to it as a "large" firm. Firm 4 is small enough that the only acquisition it can make, acquiring Firm 5, does not make it larger than Firm 1 and hence it cannot become immune against being acquired. However, it can become the second-largest firm by acquiring Firm 5. Below we refer to it as a "small" firm. Firm 3 is large enough that it can make an acquisition (of Firm 4) that makes it larger than Firm 1 and hence immune against being acquired. However, it is also small enough that it can make an acquisition (of Firm 5) that increases its attractiveness as a target and hence its likelihood of being acquired. Below we refer to it as a "medium-size" firm. Hence, in this model we have "large," "medium-size," and "small" firms. In contrast, in the two models in Section I, all firms (except the smallest) were "large," and in the model in Section II, all firms (except Firm 1) were "small." The remainder of the model is as before. Proposition 4 gives an informal version of the equilibrium merger dynamics that summarizes the key insights. In the Appendix, we give the exact formulation, which shows the equilibrium merger activity in all of the many different parameter regions.

PROPOSITION 4: *If private benefits w are low, Firm 4 or Firm 3 acquires Firm 5 at date 0 or in the good state at date 1. Then Firm 1 acquires the combined firm in the good state at date 1. All these acquisitions are profitable. If private benefits w are high, Firm 2 acquires Firm 5, either at date 0 or in the good state at date 1, and Firm 3 acquires Firm 4 in the good state at date 1. Both acquisitions are unprofitable. If private benefits w are very high, Firm 4 acquires Firm 5 at date 0. This acquisition is unprofitable. Then Firm 1 acquires the combined entity in the good state at date 1 in a profitable acquisition.*

Unlike in the previous models, there are differences in the behavior of firms (beyond that Firm 1, due to its special role, behaves differently from the other firms). The key new results relative to the earlier models concern the effect of acquirer and target size on the profitability and frequency of acquisitions.

Proposition 4 shows that large firms (Firm 2) tend to do negative NPV acquisitions, while small firms (Firm 4) tend to do positive NPV acquisitions. Large firms have the greatest incentive to make defensive acquisitions, because they are large enough to become immune against being acquired.

However, they cannot engage in profitable, positioning acquisitions since any acquisition makes them too large to be acquired. Small firms are too small to be able to use an acquisition to avoid becoming a target of the largest firm. However, they have an incentive to become larger so as to increase their attractiveness as a target, thereby earning a takeover premium. As can be seen from the detailed formulation of Proposition 4 in the Appendix, Firm 4's acquisition of Firm 5 is typically (in all but one of the many different parameter regions) profitable. There is only one exception: For very high private benefits, this acquisition is unprofitable.[32] Medium-size firms (Firm 3) can make and may have an incentive to make either defensive or positioning acquisitions. Hence, they make acquisitions that are sometimes profitable and sometimes unprofitable.

Proposition 4 also shows that acquisitions of larger targets tend to be less profitable than acquisitions of smaller targets. In particular, acquisitions of Firm 4 are always unprofitable while acquisitions of Firm 5 are profitable, with two exceptions (if Firm 2 acquires Firm 5 and if Firm 4 acquires Firm 5 for very high private benefits).[33] The intuition is that the acquisition of a large target is more likely to be motivated by defensive motives (since it makes the acquirer much larger and hence more likely to be larger than Firm 1) while the acquisition of a small target has less defensive, but more positioning, value.

Moreover, there are two mergers for low as well as high private benefits, unlike in the previous models. Hence, mixed firm size industries are most likely to generate merger waves following regime shifts. If private benefits are low, firms with positioning merger opportunities want to acquire other firms to become larger and hence a more attractive target for Firm 1. One of them eventually is acquired by Firm 1 in the good state at date 1 after having acquired another firm itself. On the other hand, if private benefits are high, firms with defensive merger opportunities want to acquire other firms to avoid being acquired, and these defensive mergers come in waves.[34]

[32] While Firm 4 is too small to protect its independence for two periods, this acquisition secures its independence at date 0 and in the bad state at date 1, and Firm 4's manager is willing to overpay for Firm 5 for this reason. The insight that acquirer size affects the profitability of acquisitions is already suggested by a comparison of Propositions 2 and 3, since in the model leading to Proposition 2 there were only large acquirers and in the model leading to Proposition 3 only small acquirers (except Firm 1). However, it was not clear that the profitability of acquisitions was driven by acquirer size alone, because all targets were large in the model leading to Proposition 2 while they were small in the model leading to Proposition 3. In the model of this section, we can distinguish between the effect of acquirer and target size.

[33] This can be seen more clearly from the exact formulation of Proposition 4 in the Appendix.

[34] As in the previous models (except the three-firm model), it is not clear whether date 0 acquisitions are more or less profitable than date 1 acquisitions. Sometimes the early acquisition is less profitable (for example, if Firm 3 or Firm 4 acquires Firm 5 at date 0 and then Firm 1 acquires the combined company in the good state at date 1). In other instances the early acquisition is more profitable (for example, if Firm 2 acquires Firm 5 at date 0 and then Firm 3 acquires Firm 4 in the good state at date 1).

IV. Discussion of Assumptions and Model Features

A. Firm Size and the Anticipation of Mergers

In our models, firm size is given by the stand-alone value of the firms. In principle, firm size should be the (equity) market value of the firms. For example, the anticipation of Firm 2's acquisition of Firm 3 in the three-firm model should already be reflected in the market values of both firms at date 0. Firm 2's value before the acquisition should be lower than C_2 because it will engage in a negative NPV acquisition. Firm 3's value should be higher than C_3 because it will earn a premium. We have ignored this issue and assumed for simplicity that the market does not anticipate the acquisitions, perhaps due to some unmodeled uncertainty.

Anticipating mergers could affect the size ordering of firms. Firm 2 may not be able to acquire Firm 3 since its market value (but not its stand-alone value) may be smaller than Firm 3's. We have checked the robustness of our results to these modeling issues for the three-firm and the four-firm models. In particular, we have analyzed a model in which the premium is as in the model we presented, but limited such that the acquirer is not smaller than the target once the merger is fully anticipated (however, the premium has to be still at least zero). Our results do not change once we adjust the assumptions on the stand-alone values of the firms slightly.[35] In the empirical implications section and our empirical tests below, we assume that an (un)profitable acquisition leads to a positive (negative) acquirer announcement return. This is a reasonable interpretation if acquisitions are not perfectly anticipated, which seems to be a realistic assumption.

B. Only One Acquisition per Firm and the Role of the Largest Firm

We make the simplifying assumption that each firm can only make one acquisition. Consider the three-firm model. If Firm 2 could engage in two acquisitions, it might acquire Firm 1 in the good state at date 1 after acquiring Firm 3 at date 0. Anticipating this, Firm 1 might want to protect its independence by acquiring Firm 3 at date 0. Such an acquisition would also ensure that Firm 2 would be available as a takeover target in the good state at date 1. Hence, allowing multiple acquisitions per firm could create incentives for Firm 1 to engage in date 0 acquisitions (which may or may not be defensive). This would not affect the main insights from the model, but may perhaps make the three-firm model more realistic. However, it would complicate the analysis. We conjecture that allowing only one acquisition per firm is less restrictive in the other models with four or five firms.[36]

[35] However, we have not performed the same robustness analysis for the two five-firm models, since the models become exceedingly complicated once all mergers are anticipated.

[36] There is no reason for Firm 1 to make a date 0 acquisition in the four-firm model since even without a date 0 acquisition it can always acquire another firm in the good state at date 1 and it benefits from mergers between the other firms since it prefers to acquire the largest possible firm.

In a more general (and realistic) model, acquiring a larger firm would be more difficult but not impossible. Then the largest firm might also have to worry about becoming a takeover target. Hence, the largest firm's behavior in our models is so simple only because of the simplifying assumptions that make our models tractable. As a consequence, one should not draw any empirical implications from the behavior of the largest firm in our models. Of course, our models also abstract from other reasons why such very large firms may engage in negative NPV acquisitions. For example, their managers may be more interested in empire-building or less disciplined by the takeover market precisely because they are more difficult to acquire.

V. Empirical Implications

The theory developed in this paper can explain several stylized facts about mergers, as discussed in the Introduction. Table II summarizes some of the empirical implications of our theory. Table III summarizes some of the main findings from the large empirical literature on mergers and indicates which our theory can and which our theory cannot explain. We also list the alternative major merger theories that can explain the individual stylized facts.

A key factor affecting the profitability of acquisitions is firm size (see column (6) of Table II). We expect a negative correlation between acquirer returns and acquirer size, consistent with the findings in Moeller, Schlingemann, and Stulz (2004), who find that very large acquirers have negative announcement returns and small acquirers have positive announcement returns.[37] This finding holds if one measures firm size using market values, or, perhaps closer to a literal interpretation of stand-alone values in our model, book values.[38] Unlike in this empirical literature, which focuses on absolute firm size, in our models "size" refers to relative size—size relative to the largest firm in the industry with profitable acquisition opportunities. We still believe that our models can explain existing size findings to some extent, because size in the sense of our models and absolute size are highly correlated. Using the data introduced in the next section, the correlation between absolute size and size relative to the largest firm in the industry is 0.48.[39]

A negative correlation between acquirer returns and acquirer size could also arise if one assumes that small firms suffer less from agency problems than

In the five-firm models, Firm 1 might have an incentive to acquire another firm at date 0, but by the time it moves this acquisition opportunity is unlikely to still be available.

[37] Moeller, Schlingemann, and Stulz (2004) show that the equally weighted acquirer announcement return is 1.1% but the acquiring firm's shareholders lose on average more than $25 million upon the announcement. This suggests that a subset of large acquirers have negative announcement returns. They also show that small acquirers (defined as firms whose market capitalization is in the lowest 25% of NYSE firms) have strongly positive announcement returns while large acquirers (top 75% of NYSE firms) have announcement returns of about zero.

[38] Stand-alone values could also be estimated from market values by subtracting from the market values the value change due to takeovers anticipated by the market.

[39] The correlation is even larger in the regime-shift subsamples we focus on.

Table II

Empirical Implications

(1) Model (Section of Paper)	(2) Ratio of Size of Largest Firm to Size of Other Firms	(3) Firm Size Distribution (Ignores Smallest Firm)	(4) Average Profitability of Acquisitions	(5) Number of Mergers (Merger Waves)	(6) Firm Size and Profitability (NPV) of Acquisitions
Basic model (I.A, I.B)	Low	All firms large	Low	Only one merger possible.	Large firms (except Firm 1): Negative NPV
Firms of similar size (I.D)	Low	All firms large	Low	2 mergers (merger wave) if PB high	Large firms (except Firm 1): Negative NPV
Dominant firm (II)	High	All firms except Firm 1 small	High	2 mergers (merger wave) if PB low	Small firms: Positive NPV
Some, but not all firms of similar size (III)	Intermediate	Firm 2 large, Firm 3 medium-size, Firm 4 small	Intermediate	2 mergers (merger wave) if PB low and if PB high	Large firms (except Firm 1): Negative NPV Small firms: Positive NPV unless PB very high Medium-size firms: positive as well as negative NPV
Empirical implication			Test I: Positive correlation between ratio of size of largest firm to size of other firms and acquirer CARs	Test II: Positive correlation between fraction of medium-size firms and acquisition likelihood	Negative correlation between acquirer size and acquirer CARs

Table III

Relationship between Merger Theories and Stylized Facts

This table presents some key empirical findings from the merger literature and states whether the theory presented in this paper can explain them. It also lists alternative merger theories that can explain the findings. If it is indicated that a theory cannot explain a finding or a theory is not listed as being able to explain it, it does not necessarily mean that the theory is inconsistent with the finding.

Finding	Can the Eat-or-Be-Eaten Theory Explain This Finding?	Other Merger Theories That Can Explain This Finding
Mergers are concentrated in certain industries and a response to industry shocks (Mitchell and Mulherin (1996))	Yes	Neoclassical Theory
Acquirer cumulative abnormal returns (CARs) on average negative (see the list of papers in footnote 3)	Yes	Managerial Theory Hubris Theory
Acquirer CARs are lower for large acquirers than for small acquirers, for whom they are positive (Moeller, Schlingemann, and Stulz (2004))	Yes	Managerial Theory
Mergers come in waves (Mitchell and Mulherin (1996), Harford (2005))	Yes	Neoclassical Theory Misvaluation Theory
Acquirer CARs lower in stock-financed acquisitions of public targets but higher in stock-financed acquisitions of private targets (Chang (1998), Fuller, Netter, and Stegemoller (2002)); acquirer long-term abnormal returns lower in stock-financed acquisitions (Loughran and Vijh (1997))	No	Misvaluation Theory (for long-term acquirer abnormal returns)
Acquirer CARs lower in acquisitions of public targets (Chang (1998), Fuller, Netter, and Stegemoller (2002))	No	None
Acquirer CARs higher in tender offers than mergers (Jensen and Ruback (1983))	No	None
Acquirer CARs lower if there are competing bidders (Bradley, Desai, and Kim (1988))	No	Hubris Theory
Defensive acquisitions succeed in reducing the probability of being acquired (Louis (2004))	Yes	None
Acquirer CARs lower and negative in defensive acquisitions (Louis (2004))	Yes	None
Acquirer CARs depend on firm size distribution in industry (this paper, Section VI)	Yes	None
Likelihood of making an acquisition depends on firm size distribution in industry (this paper, Section VI)	Yes	None
Probability of being acquired decreases in firm size (Hasbrouck (1985), Palepu (1986))	Yes (by assumption)	None

large firms or their managers are less subject to hubris. Managers in large firms tend to own a smaller percentage of the firm's shares than those of small firms (Moeller, Schlingemann, and Stulz (2004)). Moreover, large firms have larger or less cohesive boards, which tend to be less effective (Yermack (1996)).[40] These theories provide plausible explanations for the size effect. We believe that defensive and positioning motives contribute to the size effect. In addition, these alternative managerial theories have difficulty explaining some of the other empirical findings mentioned above (for example, the concentration of mergers in industries undergoing a regime shift).

There are some additional implications of our theory that may discriminate more easily between our theory and other managerial theories. We predict that medium-size firms are the most likely to engage in acquisitions (see Proposition 4). Moreover, one of the key implications of our theory is that the firm size distribution should affect acquirer announcement returns as well as the likelihood of making an acquisition. Since existing merger theories do not focus on the distribution of firm sizes, implications related to it have not been tested and are a good way to discriminate between our theory, in which they play a role, and other theories, in which they do not play a role. We present two such tests in the next section.

Our theory has several additional implications and is consistent with several other findings. For example, in a study of the U.S. banking industry, Louis (2004) shows that acquisitions can serve a defensive purpose and then are unprofitable, as in our theory. Our theory can also explain the positive correlation between managerial equity ownership and acquirer announcement returns[41] (see Lewellen, Loderer, and Rosenfeld (1985)).[42] It also predicts a negative correlation between acquirer returns and absolute target or deal size, because larger acquisitions are more likely to be defensively motivated (see the discussion after Proposition 4), and a negative correlation between the ratio of the target's to the acquirer's size and acquirer returns for medium-size firms (see Proposition 4).

Of course, there are also a number of empirical findings in the literature that our theory cannot explain. It is not inconsistent with these findings, but the features of mergers central to them play no role in our theory. For example, as indicated in Table III, our theory cannot explain (1) why acquirer returns are lower in stock-financed acquisitions of public firms but higher in stock-financed acquisitions of private firms; (2) why acquirer returns are higher in tender offers than in mergers; (3) why acquirer returns are lower in takeover contests

[40] We are grateful to an anonymous referee for suggesting these explanations.

[41] In general, there is a positive correlation between managerial stock ownership and acquirer returns as well as a negative correlation between private benefits and acquirer returns in our models. The only exception is that in heterogeneous firm size industries all acquisitions are profitable and hence there is no obvious correlation between managerial equity stakes (or private benefits) and acquirer returns (see Proposition 3).

[42] Agrawal and Mandelker (1987) find that the smaller the ownership stake of top managers (in the form of shares and options), the more likely it is that mergers or sell-offs reduce the variance of returns on the firm's assets or reduce its leverage—goals that are in the managers', but not necessarily the shareholders', interests.

with multiple bidders; and (4) why acquirer returns are lower in acquisitions of public targets. Several of these findings are also not explained by existing major merger theories. These findings are often related to details in deal structures that such theories (and our theory) do not address.

VI. Tests of the Theory

A. Hypotheses

We expect managers to have the strongest motivations for positioning and defensive acquisitions following regime shifts that significantly increase the potential of value-increasing merger opportunities. However, the mix of positioning and defensive acquisitions should depend on industry structure. In dominant-firm industries, the largest firm is much larger than other firms in the industry. This makes it more difficult for a firm to deter future acquisitions with a defensive merger and more attractive to engage in positioning acquisitions. More generally, our models imply a higher proportion of (positive NPV) positioning acquisitions relative to (negative NPV) defensive acquisitions when the largest firm is larger relative to other firms (see Table II, columns (2) and (4)):[43]

> Following a regime shift, the *profitability* of acquisitions is increasing in the ratio of the size of the largest firm in the acquirer's industry to the size of other firms in its industry, all else equal. Hypothesis (H1)

While the relative size of the largest firm influences the average profitability of acquisitions, the number of mergers in our models is based on the share of medium-size firms. We predict that the probability that a firm makes an acquisition should increase with the share of medium-size firms in its industry. To see this, compare the equilibrium in the model of Section III to those in the models in Sections I and II (see Table II, column (5)). There are two acquisitions in the equilibrium in Section III for low as well as high private benefits, something not true for the equilibria of the other models. The key difference between the model in Section III and the earlier models is the presence of a medium-size firm.[44] This leads to our second hypothesis:

[43] In dominant-firm industries, the largest firm tends to be larger relative to the other firms than in mixed firm size industries; similarly, the largest firm in mixed firm size industries tends to be larger relative to the other firms than in homogenous firm size industries. Moreover, in dominant-firm industries, all acquisitions are profitable (because there are no defensive acquisitions), while in mixed firm size industries there is a mixture of profitable and unprofitable acquisitions (because of a mixture of positioning and defensive acquisitions). In homogenous firm size industries, there is also a mixture of profitable and unprofitable acquisitions, but, taking into account all the different parameter regions, there tends to be an even larger fraction of unprofitable acquisitions than in mixed firm size industries (because there are no positioning acquisitions; see Table I). Hence, our theory predicts a positive correlation between the size of the largest firm relative to other firms in an industry and the average profitability of acquisitions in that industry (see Table II, column (4)).

[44] As Proposition 4 shows, the additional mergers may not come exclusively from medium-size firms. Note also that in an alternative model where small and large firms coexist but there is no medium-size firm, there would not necessarily be two mergers for low as well as high private benefits.

Following a regime shift, the *quantity* of mergers is increasing in the proportion of medium-size firms in an industry, all else equal. Hypothesis (H2)

B. Data

Our data include firms that are in both the CRSP and Compustat databases. Acquisition data consist of completed mergers and acquisitions by U.S. firms as given in the Securities Data Corporation (SDC) database, and we assign dates based on the first announcement of the merger.[45] We define a merger as an acquisition of equity where one firm purchases at least 50% of another and, after the purchase, the bidder owns at least 90% of the target. Thus, we do not include gradual acquisitions. We also require that the price paid for the target is at least $1 million. To ensure that the merger is strategically important, we require that the price paid for the target is at least 5% of the market value of the acquirer. We also drop all acquisitions where this ratio is greater than 150%, as these likely reflect reverse mergers or other special circumstances (or data errors).

Our theory applies to industries in which a regime shift makes future profitable acquisitions likely, and hence we need to determine when these regime shifts occur. One way to do this is to look for changes in factors such as regulation or technology that may be associated with regime shifts. Alternatively, one can look at merger waves and assume that the wave occurred because of a regime shift. These two methods are likely to produce similar outcomes, since merger waves tend to follow changes in regulation or technology (Mitchell and Mulherin (1996)). The strength of the first method is that it is an ex ante proxy for regime shifts. Unlike the second method, it does not presuppose that a regime shift leads to a merger wave. However, it is difficult to identify which technology shifts are likely to lead to merger waves, and hence we end up relying on regulatory changes. This limits us to examining regulated industries. To include other industries that are likely to experience a regime shift, we use the second method.

We take the regulatory changes from Table 3B in Harford (2005), which is based on Tables 10.2 and 10.3 in Viscusi, Harrington, and Vernon (2000). This identifies 19 major changes in regulation in six industries over the period from 1981 to 1996.[46] We refer to these as Viscusi events and take them as the basis for our first measure of regime shifts. Our measure of merger waves is taken from Harford (2005). He identifies 34 industry-specific waves in 28 industries starting during the period from 1985 to 1999; we refer to these as Harford waves. Table IV has summary statistics for our two samples of mergers. We include years and industries where there are regime shifts and, following Harford, we

[45] We do not include mergers where the target is listed as a government organization or joint venture.

[46] We follow Harford (2005) in using Fama and French (1997) industry definitions, a common approach in merger studies. Fama and French divide firms into 48 industries.

Table IV

Summary Statistics for the Merger Samples Used for the Determinants of Acquirer Cumulative Abnormal Returns

This table contains summary statistics for the sample merger observations in industries with regime shifts. A Viscusi event is a regulatory change from Table 3B in Harford (2005), based on Tables 10.2 and 10.3 in Viscusi, Harrington, and Vernon (2000). A Harford wave is a merger wave identified by Harford (2005). All variables are defined in Table VIII.

	Viscusi Events		Harford Waves	
	Mean	Median	Mean	Median
CAR	0.010	0.003	0.014	0.005
Log top two size ratio	0.490	0.326	0.569	0.373
Log 123–456 size ratio	0.609	0.540	0.835	0.648
Cash	0.333	0.000	0.339	0.000
Ratio	0.260	0.153	0.272	0.176
Market value ($ billion)	0.996	0.267	2.220	0.299
Tar priv	0.326	0.000	0.424	0.000
Tar sub	0.338	0.000	0.261	0.000
Cross industry	0.216	0.000	0.312	0.000
Competing bid	0.009	0.000	0.015	0.000
Tender offer	0.017	0.000	0.034	0.000
Stock market return	0.253	0.187	0.342	0.261
Market/book	1.897	1.424	2.669	1.979
Industry Herfindahl	0.048	0.024	0.068	0.050
Observations	654		1,334	

examine 2-year windows for each regime shift.[47] The Viscusi event sample has 654 mergers with a total deal value of $986 billion while the Harford wave sample has 1,334 mergers with a total deal value of $1,862 billion.

C. Determinants of Acquirer Abnormal Returns

To test the first hypothesis (H1), we use the relative size of the largest firm(s) in the acquirer's industry. We measure relative size as the ratio of the market value of the largest firm in the acquirer's industry to the market value of the second-largest firm (among all firms with CRSP data). Let *Log top two size ratio*$_{i,t}$ be the logarithm of this ratio for industry i in year t. Since the largest firm in an industry may not always be a potential acquirer, we also examine the logarithm of the ratio of the average size of the three largest firms in the acquirer's industry to the average size of the next three largest firms (*Log 123–456 size ratio*$_{i,t}$).

Acquisition profitability, that is, the value created for acquiring firm shareholders from a merger, is measured using the cumulative abnormal announcement return (CAR) for the 3 days surrounding a merger announcement. Let

[47] SDC data from 1981 are sparse, and hence we include only data starting in 1982. Thus, we miss the first year of two Viscusi events.

$CAR_{j,i,d}$ be the cumulative difference between the return on firm j's stock in industry i and the return on the *CRSP* value-weighted index for the 3 trading days starting the day before a merger announcement on date d. We expect a smaller CAR, all else equal, for defensive acquisitions and a larger one for positioning acquisitions. We test this using

$$CAR_{j,i,d} = \alpha + \beta\, Log\ top\ two\ size\ ratio_{i,t} + \gamma \text{ control variables} + \varepsilon \qquad (5)$$

for an acquisition by firm j in industry i at date d, where the industry structure is measured as of the end of the year prior to the announcement. In all the regressions, we calculate robust standard errors, including controls for firm-level cluster effects. Hypothesis (H1) implies $\beta > 0$.

In (5), we control for factors known to affect the CAR from an acquisition. We include a dummy variable that is one if an acquisition is paid for using all cash ($Cash_{j,d}$) and zero otherwise to control for the means of payment (Travlos (1987)). We control for the ratio of the price paid for the target, our proxy for target size, to the market value of the acquirer ($Ratio_{j,d}$) (Moeller, Schlingemann, and Stulz (2004)).[48] Since firm size can affect the CAR (Moeller, Schlingemann, and Stulz (2004)), we include the logarithm of the acquirer's equity market value ($Log\ value_{j,t}$). The regressions contain dummy variables for whether a target is private ($Tar\ priv_{j,d}$) or a subsidiary ($Tar\ sub_{j,d}$), with public targets as the omitted group (Fuller, Netter, and Stegemoller (2002)). We also include dummy variables for cross-industry mergers ($Cross\ industry_{j,d}$) (see Morck, Shleifer, and Vishny (1990)), for whether there is a competing bidder ($Competing\ bid_{j,d}$) (see Bradley, Desai, and Kim (1988)), and for whether the acquisition is a tender offer ($Tender\ offer_{j,d}$) (see Jensen and Ruback (1983)).

We also use several additional firm-specific control variables that may affect merger activity and acquirer returns. Firm health is accounted for using the increase in a firm's stock price in year t ($Stock\ market\ return_{j,t}$) and the firm's market-to-book ratio ($Market/book_{j,t}$) (Rau and Vermaelen (1998)).[49] Strong performance can give firms more currency to make acquisitions or it may indicate that the firm is overvalued, making an acquisition more likely (Harford (2005), Shleifer and Vishny (2003)). We include the industry's Herfindahl index ($Industry\ Herfindahl_{i,t}$) because industry concentration could affect merger activity. There are year dummies to pick up any economy-wide factors that affect the probability of merging and industry dummies to capture time-invariant industry characteristics.

The first and third columns of Table V present estimated coefficients when we regress the CAR on the independent variables using (5) for Viscusi events and Harford waves, respectively. The results indicate that the CAR is increasing in *Log top two size ratio*, which is statistically significant.[50] This result is

[48] We use the value offered for the target rather than the value of the target because many targets are not publicly traded, and thus we do not have a value for them.

[49] With the exception of market value and the dummy variables, we winsorize all the firm-specific control variables at the 5% level. The results are robust to using the raw data.

[50] The results in the table are robust to various changes in variable definitions and the sample.

Table V

Determinants of Acquirer Cumulative Abnormal Returns

This table contains OLS regression results for the sample merger observations. A Viscusi event is a regulatory change identified in Table 3B in Harford (2005), based on Tables 10.2 and 10.3 in Viscusi et al. (2000). A Harford wave is a merger wave identified by Harford (2005). All variables are defined in Table VIII. The regressions have robust standard errors corrected for acquirer cluster effects (robust p values reported in parentheses). * statistically significant at the 10% level; ** statistically significant at the 5% level; *** statistically significant at the 1% level. Year and industry dummies not shown.

	Viscusi Events		Harford Waves	
	(1)	(2)	(3)	(4)
Log top two size ratio	0.072		0.021	
	(0.036)**		(0.021)**	
Log 123–456 size ratio		0.074		0.029
		(0.008)***		(0.007)***
Cash	−0.003	−0.002	0.001	0.001
	(0.579)	(0.679)	(0.800)	(0.881)
Ratio	0.039	0.039	0.004	0.003
	(0.000)***	(0.000)***	(0.565)	(0.694)
Log value	−0.001	−0.001	−0.005	−0.006
	(0.722)	(0.633)	(0.000)***	(0.000)***
Tar priv	0.017	0.017	0.015	0.015
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Tar sub	0.021	0.020	0.022	0.022
	(0.001)***	(0.002)***	(0.000)***	(0.000)***
Cross industry	0.007	0.007	0.007	0.007
	(0.238)	(0.224)	(0.107)	(0.104)
Competing bid	−0.038	−0.038	0.007	0.006
	(0.141)	(0.130)	(0.698)	(0.720)
Tender offer	0.004	0.006	0.017	0.017
	(0.828)	(0.740)	(0.065)*	(0.056)*
Stock market return	−0.001	−0.001	−0.000	−0.001
	(0.935)	(0.818)	(0.922)	(0.861)
Market/book	0.001	0.001	0.002	0.002
	(0.618)	(0.672)	(0.082)*	(0.080)*
Industry Herfindahl	−0.209	−0.203	−0.036	0.036
	(0.060)*	(0.017)**	(0.723)	(0.720)
Observations	654	654	1,334	1,334
R^2	0.146	0.149	0.112	0.113

consistent with (H1). As shown in the second and fourth columns of the table, using *Log 123–456 size ratio* as the measure of size ratios generates similar results. The effect of changes in market structure on the profitability of acquisitions is economically significant as well as statistically significant. Increasing

We use the same wave length as Harford (2005), but changing the wave length to 3 years does not change the qualitative results. Also, we can replace the size ratios with ordinal versions without losing support for our model. The results are also robust to dropping the wave with the most mergers.

Log top two size ratio by one standard deviation increases the CAR by 0.026 (2.6 percentage points) for Viscusi events and 0.035 for Harford waves, which are large changes compared to the mean CARs of 0.010 for Viscusi events and 0.014 for Harford waves.

The other coefficients generally are consistent with what is expected, although not all coefficients are statistically significant in all regression specifications. The CAR increases as relative target size increases and firm size decreases (as in Moeller, Schlingemann, and Stulz (2004)). Acquisitions of nonpublic targets lead to higher CARs (as in Fuller, Netter, and Stegemoller (2002)), and there is some evidence that firms that make tender offers have higher CARs (as in Jensen and Ruback (1983)). In addition, we find that firms in less concentrated industries tend to have higher CARs.

D. Determinants of the Probability of Making an Acquisition

To test hypothesis (H2), we require a definition of a medium-size firm. In the spirit of our models, a medium-size firm is one large enough that some acquisitions can serve as deterrents, but also small enough that other mergers can make the firm a more attractive merger target. The precise size range depends on the size of the largest potential suitor for a firm. In the models, for simplicity we assume that the largest suitor is the same as the largest firm. While this is without loss of generality in the models, it is not necessarily true in practice. This means that a firm need not be at least 50% of the size of the largest firm to deter all likely acquisitions. Moreover, firms are not restricted to one acquisition, but can grow larger through a series of acquisitions. For these reasons, we choose the medium-size range to capture firms that are not the largest in an industry, but are relatively large compared to the mass of firms. There are enough firms larger than these firms so that they are likely to be threatened by takeover from at least some larger firm, but they are big enough that by making a major acquisition, they may be able to deter some potential acquirers. At the same time, they are small enough to become more attractive targets if they make smaller acquisitions.

We define a medium-size firm as one with total assets that are between 5% and 30% of the total assets of the largest firm in the industry in that year (henceforth referred to as the size ratio). As with the tests of (H1), we use both Viscusi events and Harford waves to test (H2). However, for these tests, we include all firms in an industry in the years when there is a regime shift, not just acquirers (because we want to estimate the likelihood of being an acquirer). Table VI gives summary statistics for our samples. For Viscusi events, 5.1% of firms are large and 12.6% medium-size. This means that medium-size firms are, as we desire, large relative to the mass of smaller firms. The firm size shares are similar for Harford waves, although the proportion of small firms is slightly larger.

Let $Future\ merger_{j,i,t}$ be a dummy variable that takes on the value of one if firm j in industry i announces an acquisition in year $t + 1$ and the acquisition is subsequently completed (that is, we classify mergers by their announcement

Table VI

Summary Statistics for the Merger Samples Used for the Determinants of the Probability of Making an Acquisition

This table contains summary statistics for the industries with regime shifts. A Viscusi event is a regulatory change from Table 3B in Harford (2005), based on Tables 10.2 and 10.3 in Viscusi, Harrington, and Vernon (2000). A Harford wave is a merger wave identified by Harford (2005). All variables are defined in Table VIII.

	Viscusi Events		Harford Waves	
	Mean	Median	Mean	Median
Future merger	0.092	0.000	0.092	0.000
Share of industry that is small (size ratio < 5%)	0.822	0.862	0.864	0.905
Share of industry that is medium-size (size ratio ∈ [5%, 30%]): Pct medium-size firms	0.126	0.088	0.101	0.066
Share of industry that is large (size ratio > 30%)	0.051	0.031	0.035	0.025
Market value ($ billion)	1.507	0.157	1.683	0.132
Stock market return	0.165	0.133	0.176	0.126
Market/book	1.732	1.331	2.469	1.696
Equity/assets	0.304	0.267	0.420	0.409
EBITDA/sales	0.173	0.185	−0.108	0.099
Asset growth rate	0.128	0.053	0.157	0.073
Industry Herfindahl	0.051	0.024	0.087	0.051
Recent acquisition	0.098	0.000	0.099	0.000
Observations	6,499		11,341	

date rather than the completion date) and is otherwise zero. The mean value of $Future\ merger_{j,i,t}$ for both samples is 0.092, which means that there was at least one acquisition in 601 firm-year observations for Viscusi events and 1,044 firm-year observations for Harford waves. The total number of mergers is larger than this, since some firms made more than one acquisition in a calendar year. To test whether the distribution of firm size affects acquisition activity, we use the logistic regression:

$$Future\ merger_{j,i,t} = f(Pct\ medium\text{-}size\ firms_{i,t},\ \text{control variables}), \quad (6)$$

where $Pct\ medium\text{-}size\ firms_{i,t}$ is the proportion of firms in industry i in year t that are between 5% and 30% of the asset size of the largest firm in the industry. Hypothesis (H2) predicts that the coefficient on $Pct\ medium\text{-}size\ firms_{i,t}$ is positive.

Again, we include firm-specific variables to control for other factors that may affect merger activity. We include a measure of firm size (Harford (1999)), the logarithm of market value ($Log\ value_{j,t}$), the increase in a firm's stock price in year t ($Stock\ market\ return_{j,t}$), the firm's market-to-book ratio ($Market/book_{j,t}$), the (accounting) equity-to-asset ratio ($Equity/asset_{j,t}$), and a proxy for free cash

Table VII

Determinants of the Probability of Making an Acquisition

This table reports logistic regressions with the dependent variable *Future merger*. A Viscusi event is a regulatory change from Table 3B in Harford (2005), based on Tables 10.2 and 10.3 in Viscusi, Harrington, and Vernon (2000). A Harford wave is a merger wave identified by Harford (2005). All variables are defined in Table VIII. The regressions have robust standard errors corrected for firm cluster effects (robust p values reported in parentheses). The marginal effect associated with the coefficient on *Pct medium-size firms* is reported in italics. * statistically significant at the 10% level; ** statistically significant at the 5% level; *** statistically significant at the 1% level. Year and industry dummies not shown.

	Viscusi Events	Harford Waves
Pct medium-size firms	5.170	3.729
	(0.070)*	(0.021)**
Marginal effect	*0.434*	*0.312*
Log value	0.063	0.139
	(0.005)***	(0.000)***
Stock market return	0.213	0.088
	(0.045)**	(0.096)*
Market/book	−0.008	0.005
	(0.698)	(0.693)
Equity/assets	0.088	0.043
	(0.756)	(0.819)
EBITDA/sales	0.266	0.195
	(0.128)	(0.061)*
Asset growth rate	0.289	0.429
	(0.013)**	(0.000)***
Industry Herfindahl	1.021	0.796
	(0.386)	(0.724)
Recent acquisition	1.466	1.140
	(0.000)***	(0.000)***
Pseudo R-squared	0.080	0.087
Observations	6,499	11,341

flow ($EBITDA/sales_{j,t}$, Andrade and Stafford (2004)). Some firms may also be more likely than others to engage in acquisitions, possibly as part of a growth program (Rosen (2005)). Thus, we include the growth rate of assets in year t ($Asset\ growth\ rate_{j,t}$) and a dummy variable for whether the firm made an acquisition in year t ($Recent\ acquisition_{j,t}$) as control variables. As above, we include the industry's Herfindahl index ($Industry\ Herfindahl_{i,t}$), year dummies, and industry dummies.

Table VII presents the regression results. The coefficient on *Pct medium-size firms* is positive and statistically significant at the 10% level for Viscusi waves and at the 5% level for Harford waves, indicating that firms in industries with a larger proportion of medium-size firms are more likely to make acquisitions, consistent with (H2).[51] This new result provides evidence in support of our theory. The effect is fairly large. Evaluated at the mean of the dependent variable, an increase in the percentage of medium-size firms in its industry increases the

[51] The results in the table are robust to some changes, such as relaxing the definition of *Pct medium-size firms* to include firms up to 40% of the size of the largest firm.

Table VIII

Definitions of Variables

This table provides the definitions of variables used in Tables IV, V, VI, and VII.

Variable	Definition
CAR	The acquirer's cumulative abnormal return for 3 days surrounding the merger announcement
Log top two size ratio	The log of the ratio of the size (measured by equity value) of the largest firm to the second-largest firm in the acquirer's industry
Log 123–456 size ratio	The log of the ratio of the average size of the three largest firms to that of the next three largest firms in the acquirer's industry
Cash	A dummy variable that takes on the value of one if a merger is financed using cash only and is otherwise zero
Ratio	The ratio of the value paid for the target to the market value of the acquirer
Market value	The equity market value
Tar priv and Tar sub	Dummy variables for whether the target is private or a subsidiary (with public targets the excluded group)
Cross industry	A dummy variable that takes on the value of one if the acquirer and target are in different industries and is otherwise zero
Competing bid	A dummy variable that takes on the value of one if there was a bidder competing with the acquirer and is otherwise zero
Tender offer	A dummy variable that takes on the value of one if the acquisition technique was a tender offer and is otherwise zero
Stock market return	The return for a firm's stock in the year prior to the merger decision or announcement
Market/book	The ratio of the market value of equity to the book value of equity
Industry Herfindahl	The Herfindahl index for a firm's industry at the end of the year prior to the merger decision or announcement
Log value	The log of the equity market value
Future merger	A dummy variable that takes on the value of one if a firm acquires another firm in year $t + 1$ and is otherwise zero
Recent acquisition	A dummy variable that takes on the value of one if a firm acquires another firm in year t and is otherwise zero
Equity/assets	The ratio of book equity to total assets
EBITDA/sales	The ratio of earnings before interest, taxes, depreciation, and amortization to total sales
Asset growth rate	The rate of growth of total assets in year t
Pct medium-size firms	The share of firms in an industry that are between 5% and 30% as large as the largest firm in the industry in terms of the book value of their assets
Share of industry that is small (size ratio <5%)	The share of firms in an industry that are less than 5% as large as the largest firm in the industry in terms of the book value of their assets
Share of industry that is large (size ratio >5%)	The share of firms in an industry that are more than 30% as large as the largest firm in the industry in terms of the book value of their assets

probability of a firm making an acquisition by 0.43 percentage points per percentage point increase in *Pct medium-size firms* for Viscusi events and 0.31 for Harford waves, as indicated by the marginal effects. Projecting this for a one-standard deviation change in the percent of medium-size firms (0.081 for Viscusi events and 0.085 for Harford waves) implies an increase in the acquisition

probability for Viscusi events of 3.5 percentage points and for Harford waves of 2.7 percentage points, respectively. This corresponds to a 38.8% increase in the mean acquisition probability for Viscusi events and a 29.1% increase for Harford waves. The other results generally are consistent with intuition and earlier studies. Larger firms make more acquisitions as do firms with prior acquisitions, better recent performance, and faster recent growth. The other coefficients are not statistically significant.

Overall, the results in this section support two unique predictions of our models—that the size distribution of firms in an industry affects the profitability and frequency of acquisitions following a regime shift.

VII. Conclusion

In this paper we argue that firm size is an important determinant of merger activity in industries with economies of scale. Firms may engage in a race for size for two reasons. First, managers may want to make acquisitions to increase their firm's size and hence reduce the likelihood that it is taken over. These acquisitions, while unprofitable, may allow them to preserve their private benefits of control. Alternatively, firms may want to engage in acquisitions to become larger and hence position themselves as more attractive takeover targets. These positioning acquisitions are profitable. We show that industry structure—the size distribution of the firms in the industry—is a very important determinant of which mergers occur. Industries where many firms are similar in size to the largest firm are prone to defensive merger waves if managers care a lot about the private benefits of control. However, industries in which there is a dominant firm are less prone to waves of unprofitable acquisitions. In contrast, they may display waves of profitable acquisitions (which are more likely when managers care little about private benefits of control). In industries in which some but not all firms are of similar size, merger waves are most likely, because they occur both when private benefits are low and when they are high. The profitability of acquisitions tends to decrease in the acquirer's size. Large acquirers overpay while small acquirers tend to engage in profitable acquisitions. Firms of intermediate size sometimes engage in profitable and sometimes in unprofitable acquisitions. Overall, the race for firm size often leads to profitable acquisitions, but if private benefits are high, it may induce large firms to make unprofitable acquisitions.

Our theory can explain why mergers are concentrated in industries for which a regime shift can be identified. At the same time, it can explain why (at least very large) acquirers overpay, on average, and why mergers often occur in waves. The theory generates many additional testable empirical implications. Some of these predictions are consistent with the available empirical evidence, such as the negative correlation between acquirer announcement returns and acquirer size (Moeller, Schlingemann, and Stulz (2004)) as well as the negative acquirer returns in defensive acquisitions (Louis (2004)). We caution, though, that the notion of size in our models is slightly different from, although highly correlated with, absolute size as used in the empirical literature. We test two

empirical implications that are central to our theory. In particular, we test whether, as predicted by our models, acquisitions are more profitable in industries in which the largest firm is larger relative to the other firms, and whether firms in industries with more medium-size firms are more likely to make acquisitions. Our evidence supports these predictions. We leave the testing of our other predictions to future empirical work.

Appendix: Proofs

The proofs of Propositions 2–4 are split into parameter regions with low and high private benefits, as suggested in the formulation of the propositions in the main text. In all proofs, we derive italicized statements that describe firm behavior conditional on no acquisition having taken place yet. These results are used to find the first acquisition that occurs in equilibrium (clearly, an acquisition that occurs after another one cannot be the first acquisition). Toward the end of the proofs, we calculate whether there are additional acquisitions after the first one. Of course, we have calculated what happens in all subgames, including the ones that follow an acquisition. This is taken into account in deriving the italicized statements. We sometimes (but in the interest of brevity not always) refer to what happens in subgames following an acquisition in the calculations below if it is relevant and not obvious.

We summarize the italicized statements for all propositions in Table AI in the order in which firms move. For Proposition 2, we list these statements only for one of two parameter regions for simplicity. The other parameter region is covered in the proof of Proposition 2 and is very similar. Note that the italicized statements are derived in the proofs by backward induction and hence are listed in the opposite order in which firms move, starting with the last firm's move at date 1. The first equilibrium acquisition can be inferred from Table AI as follows. Consider Proposition 2. If $w \leq 0.5\alpha C_2$, the first firm wanting to make an acquisition is Firm 1, which acquires Firm 2 in the good state at date 1. If $w \in (0.5\alpha C_2, 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2]$, the condition under which Firm 4 acquires Firm 5 at date 0 is not satisfied. The same is true for the conditions under which Firm 3 and Firm 2 would acquire Firm 5 at date 0. The first condition that is satisfied is the condition under which Firm 4 acquires Firm 5 in the good state at date 1 ($w > 0.5\alpha C_2$). Hence, this is the first equilibrium acquisition. Finally, if $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$, the first condition that is satisfied is the condition under which Firm 4 acquires Firm 5 at date 0. Hence, this is the first equilibrium acquisition.

We derive some, but not all italicized statements, typically after the italicized statement. The proofs of the statements that we do not present here are very similar in style and left out for brevity. More detailed proofs are available from the authors upon request.

The precise statement of Proposition 2 is:

PROPOSITION 2: *If (3) holds, that is, $w \leq 0.5\alpha C_2$, Firm 1 acquires Firm 2 in the good state at date 1. This acquisition is profitable. If $w \in (0.5\alpha C_2,$*

$0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_3]$, *Firm 4 acquires Firm 5 at date 0 and then Firm 2 acquires Firm 3 in the good state at date 1 unless* $0.5\alpha C_2 < 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$ *and* $w \in (0.5\alpha C_2, 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2]$. *In this case, Firm 4 acquires Firm 5 in the good state at date 1. Then Firm 2 acquires Firm 3 in the good state at date 1. Finally, if* $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_3$, *Firm 4 acquires Firm 5 at date 0. Then Firm 2 acquires Firm 3 at date 0. All of these acquisitions are unprofitable.*

Proof of Proposition 2: We solve the model by backward induction. It is easy to show the following:

- *If no acquisition has taken place yet, there is no acquisition in the bad state at date 1.*

Now consider the good state at date 1. Firm 1 is the last firm to move. It is easy to show that Firm 1 acquires the largest remaining firm, because this

Table AI

Key Steps in Calculating the First Acquisition in Propositions 2, 3, and 4

This table shows which acquisitions each firm undertakes if no acquisition has taken place yet. One can infer from it which acquisition occurs first in equilibrium for each parameter constellation. No acquisitions occur in the bad state at date 1. The acquisition moves preceded by "If possible" occur if no previous acquisition has made this acquisition impossible. The expression "iff" means "if and only if."

Panel A. Proposition 2. This Panel Assumes $0.5\alpha C_2 < 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$.	
CASE 1: $w \leq 0.5\alpha C_2$	**CASE 2:** $w > 0.5\alpha C_2$
	Date 0
• *No acquisition*	• *4 acquires 5 iff* $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$ • *If possible, 3 acquires 5 iff* $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$ • *If possible, 2 acquires 5 iff* $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$
	Good state at date 1
• *1 acquires 2*	• *If possible, 4 acquires 5* • *If possible, 3 acquires 5* • *If possible, 2 acquires 5* • *If possible, 1 acquires 2*
Panel B. Proposition 3	
CASE 1: $w < 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)C_4$	**CASE 2**: $w \geq 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)C_4$
	Date 0
• *2 acquires 4* • *If possible, 3 acquires 4*	• *No acquisitions*
	Good state at date 1
• *If possible, 1 acquires 2*	• *1 acquires 2*

(*continued*)

Table AI—*Continued*

Panel C. Proposition 4	
CASE 1: $w < 0.5\alpha C_3 + \alpha(C_4 + C_5)$	**CASE 2**: $w \geq 0.5\alpha C_3 + \alpha(C_4 + C_5)$
	Date 0
• *4 acquires 5 iff* $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5)$ *holds or both* $w \in (0.5\alpha(C_3 + C_5), 0.5\alpha C_3 + \alpha(C_4 + C_5))$ *and* $w < -4\alpha((1-\rho)/\rho)C_5 + \alpha(C_4 + C_5) + 0.5\alpha C_3$ *hold*	• *4 acquires 5 iff* $w > 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4$
• *If possible, 3 acquires 5 iff* $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_3 + C_5)$	• *If possible, 3 acquires 4 iff* $w > 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4$
	• *If* $0.5\alpha C_3 + \alpha(C_4 + C_5) \leq 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$: *If possible, 2 acquires 5 iff* $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$.
	• *If* $0.5\alpha C_3 + \alpha(C_4 + C_5) > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$: *If possible, 2 acquires 5.*
Good state at date 1 (same for both cases)	
• *If possible, 4 acquires 5 iff* $w < 0.5\alpha(C_4 + C_5)$ *or* $w \in (0.5\alpha(C_3 + C_5), 0.5\alpha C_3 + \alpha(C_4 + C_5))$	
• *If possible, 3 acquires 5 iff* $w \leq 0.5\alpha(C_3 + C_5)$	
• *If possible, 3 acquires 4 iff* $w > 0.5\alpha(C_3 + C_5)$	
• *If possible, 2 acquires 5 iff* $w > 0.5\alpha C_2$	
• *If possible,1 acquires 2*	

is most profitable and hence best for Firm 1's manager. If no acquisition has occurred yet, the largest firm it can acquire is Firm 2:

- *If no acquisition has taken place yet, Firm 1 always acquires Firm 2 in the good state at date 1.*

Does Firm 2, which moves before Firm 1, acquire any other firm in the good state at date 1? We can show:

- *If no acquisition has taken place yet, Firm 2 acquires Firm 5 in the good state at date 1 if and only if* $w > 0.5\alpha C_2$.

If Firm 2 acquires Firm 5, its manager gets a payoff of up to (if a zero premium is paid) w. If he does not acquire Firm 5, Firm 2 is acquired by Firm 1 and Firm 2's manager receives $0.5\alpha C_2$. Hence, Firm 2 acquires Firm 5 if and only if $w > 0.5\alpha C_2$. It can be easily shown that the condition under which Firm 2 would like to acquire Firm 4 or Firm 3 is the same and that Firm 2's manager receives the same payoff regardless of which firm he acquires. By assumption, he resolves this indifference in favor of acquiring the smallest firm, Firm 5.

We separate the remainder of the proof into two cases. First, consider CASE 1: $w \leq 0.5\alpha C_2$.

We can show:

- *If no acquisition has taken place yet and if* $w \leq 0.5\alpha C_2$, *Firm 3 and Firm 4 make no acquisition in the good state at date 1 or at date 0 and Firm 1 and Firm 2 make no acquisition at date 0.*

Firm 3 moves before Firm 2. If Firm 3 acquires Firm 5, its manager receives up to w. If he does not acquire Firm 5, Firm 3 remains independent and its manager receives w. Hence, he does not acquire Firm 5. It is easy to show that he also does not acquire Firm 4. Firm 4 moves before Firm 3. If Firm 4 acquires Firm 5, its manager gets up to w. If he does not acquire Firm 5, he receives w. Hence, he does not acquire Firm 5.

Now we turn to date 0. Firm 1 is the last firm to move at this date. If Firm 1 acquires Firm j, Firm 1's manager gets up to $2w + \alpha(\rho C_j - (1-\rho)C_j)$. Because it was assumed that $\rho < 0.5$ (assumption (1)), this is less than the payoff that Firm 1's manager receives if he does not acquire Firm j, which is larger than $2w$. Hence, Firm 1 does not make an acquisition at date 0.

Firm 2 moves before Firm 1. If Firm 2 acquires Firm 5, its manager receives up to $2w - \alpha(1-\rho)C_5$. If Firm 2 does not acquire Firm 5, Firm 1 acquires Firm 2 in the good state at date 1 and Firm 2's manager receives an expected payoff at date 0 of $w + (1-\rho)w + \rho 0.5\alpha C_2$. Hence, it can be easily calculated that Firm 2 acquires Firm 5 if and only if $w > 0.5\alpha C_2 + \alpha((1-\rho)/\rho)C_5$, which is inconsistent with $w \leq 0.5\alpha C_2$. Thus, Firm 2 does not acquire Firm 5. It is easy to show that Firm 2 also does not acquire Firm 4 or Firm 3.

Firm 3 moves before Firm 2. If Firm 3 acquires Firm 5, its manager receives up to $2w - \alpha(1-\rho)C_5$. If Firm 3 does not acquire Firm 5, Firm 1 acquires Firm 2 in the good state at date 1 and Firm 3 remains independent. Then Firm 3's manager receives $2w > 2w - \alpha(1-\rho)C_5$. Hence, Firm 3 does not acquire Firm 5. One can also show that Firm 3 does not acquire Firm 4.

Finally, let us turn to Firm 4, which moves first and before Firm 3. If Firm 4 acquires Firm 5, Firm 4's manager receives a payoff of up to $2w - \alpha(1-\rho)C_5$. If Firm 4 does not acquire Firm 5, he receives $2w$. Hence, Firm 4 does not acquire Firm 5.

Now consider CASE 2: $w > 0.5\alpha C_2$. Note that the payoffs of the acquiring firm's manager are the same as in CASE 1 and hence the only potential change is the manager's payoff if he does not make an acquisition. Moreover, there are also no acquisitions in the bad state at date 1 and the conditions under which Firm 1 and Firm 2 make acquisitions in the good state at date 1 are the same as in CASE 1.

Does Firm 3, which moves before Firm 2, acquire any other firm in the good state at date 1? We can show:

- *If no acquisition has taken place yet and if $w > 0.5\alpha C_2$, Firm 3 always acquires Firm 5 in the good state at date 1.*

If Firm 3 does not acquire Firm 5, Firm 2 acquires Firm 5. Then Firm 3 is the largest remaining firm that can be and is acquired by Firm 1. In this case, Firm 3's manager receives $0.5\alpha C_3$. Hence, Firm 3 acquires Firm 5 if and only if $w > 0.5\alpha C_3$, which is implied by $w > 0.5\alpha C_2$. Thus, Firm 3 acquires Firm 5 if and only if $w > 0.5\alpha C_2$. It can be easily seen that Firm 3 would like to acquire Firm 4 under the same condition and that the payoff of Firm 3's manager in this case is the same as if he acquired Firm 5. By assumption, he resolves this indifference in favor of acquiring the smaller firm, Firm 5.

Does Firm 4, which moves before Firm 3, acquire Firm 5 in the good state at date 1? We can show:

- *If no acquisition has taken place yet and if* $w > 0.5\alpha C_2$*, Firm 4 always acquires Firm 5 in the good state at date 1.*

Now we turn to date 0. Firm 1, which is the last firm to move at this date, does not acquire any other firm, as in the parameter region $w \leq 0.5\alpha C_2$:

- *If no acquisition has taken place yet and if* $w > 0.5\alpha C_2$*, Firm 1 makes no acquisition at date 0.*

Does Firm 2, which moves before Firm 1, acquire any other firm at date 0? We can show:

- *If no acquisition has taken place yet and if* $w > 0.5\alpha C_2$*, Firm 2 acquires Firm 5 at date 0 if and only if* $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$.

If Firm 2 does not acquire Firm 5, Firm 4 acquires Firm 5 in the good state at date 1, as was shown above. One can show that then Firm 2 acquires Firm 3 in the good state at date 1 for $C_3 + 0.5(1/\alpha)(w - 0.5\alpha C_2)$. Hence, Firm 2 acquires Firm 5 at date 0 if and only if $2w - \alpha(1-\rho)C_5 > 2w - \rho 0.5(w - 0.5\alpha C_2)$, that is, $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$. It can be shown that Firm 2's manager always prefers to acquire Firm 5 to acquiring Firm 4 or Firm 3.

Does Firm 3, which moves before Firm 2, acquire any other firm at date 0? We can show:

- *If no acquisition has taken place yet and if* $w > 0.5\alpha C_2$*, Firm 3 acquires Firm 5 at date 0 if and only if*

$$w > \max\{0.5\alpha C_2, 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2\}. \tag{A1}$$

Finally, does Firm 4, which moves before Firm 3, acquire Firm 5 at date 0? Assume that $0.5\alpha C_2 < 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$. Then Firm 3 acquires Firm 5 at date 0 if and only if $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$. We can show:

- *If no acquisition has taken place yet and if* $w > 0.5\alpha C_2$ *and* $0.5\alpha C_2 < 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$*, Firm 4 acquires Firm 5 at date 0 if and only if* $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$.

If $w \in (0.5\alpha C_2, 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2]$ and if Firm 4 does not acquire Firm 5 at date 0, Firm 4 acquires Firm 5 in the good state at date 1, as seen above, for, as one can show, $C_5 + 0.5(1/\alpha)(w - 0.5(w - 0.5\alpha C_2))$. Hence, Firm 4 acquires Firm 5 at date 0 if and only if $2w - \alpha(1-\rho)C_5 > 2w - \rho 0.5(w - 0.5(w - 0.5\alpha C_2))$, that is, $w > 4\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$. Thus, Firm 4 never acquires Firm 5 in this parameter region.

If $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$ and if Firm 4 does not acquire Firm 5 at date 0, Firm 3 acquires Firm 5 at date 0, as shown above. One can calculate that then Firm 2 acquires Firm 4 at date 0 if and only if $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_4$. Otherwise, Firm 2 acquires Firm 4 in the good state at date 1. Hence, if $w \in (2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2, 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_4]$, Firm 4's manager

receives an expected payoff at date 0 of $w + (1-\rho)w + \rho 0.5(w - 0.5\alpha C_2)$. Thus, Firm 4 acquires Firm 5 at date 0 if and only if $2w - \alpha(1-\rho)C_5 > w + (1-\rho)w + \rho 0.5(w - 0.5\alpha C_2)$, that is, $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$. But this is always satisfied, because we have assumed that $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$. One can also calculate that if $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_4$, Firm 4 always acquires Firm 5 at date 0.

Now assume that $0.5\alpha C_2 \geq 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$. Then Firm 3 acquires Firm 5 at date 0 if and only if $w > 0.5\alpha C_2$. One can also show the following:

- *If no acquisition has taken place yet and if* $w > 0.5\alpha C_2$ *and* $0.5\alpha C_2 \geq 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$, *Firm 4 always acquires Firm 5 at date 0.*

To complete the proof of Proposition 2, we have to calculate which acquisition occurs first from the firms' behavior summarized in the italicized statements. It is easy to verify (keeping in mind that Firm 4 moves first, Firm 3 second, Firm 2 third, and Firm 1 last at each date) that the first acquisition in all parameter regions as described in Proposition 2 is the unique first equilibrium acquisition. For the parameter region $0.5\alpha C_2 < 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$, this can be done using the summary of the italicized statements provided in Table AI, as described in the general remarks about the proofs before the precise statement of Proposition 2.

Now let us check whether there are any additional acquisitions after the first acquisition and whether the acquisitions are profitable. Assume that $0.5\alpha C_2 < 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$. The arguments are similar if $0.5\alpha C_2 \geq 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$ and hence left out for brevity. If $w \leq 0.5\alpha C_2$, Firm 1 acquires Firm 2 in the good state at date 1. Clearly, this acquisition is profitable. Since Firm 1 is the last firm to move, there cannot be another acquisition afterward. If $w \in (0.5\alpha C_2, 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2]$, Firm 4 acquires Firm 5 in the good state at date 1. One can show easily that Firm 2 acquires Firm 3 in the good state at date 1 after Firm 4 acquires Firm 5. If $w > 2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2$, Firm 4 acquires Firm 5 at date 0. One can show that after Firm 4 acquires Firm 5 at date 0, Firm 2 acquires Firm 3 in the good state at date 1 if and only if $w \in (2\alpha((1-\rho)/\rho)C_5 - 0.5\alpha C_2, 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_3]$. Firm 2 acquires Firm 3 at date 0 after Firm 4 acquires Firm 5 if and only if $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_3$. The acquisition of Firm 5 by Firm 4 and the acquisition of Firm 3 by Firm 2 are unprofitable, both at date 0 and in the good state at date 1. The date 0 acquisitions create negative synergies but involve a positive premium. The date 1 acquisitions create zero synergies but involve a positive premium.

Proof of Proposition 3: We solve the model by backward induction. Note that there are no acquisitions after Firm 1 has made an acquisition or has not made an acquisition and no opportunity to make one anymore. The reason is that other firms make acquisitions only to increase their chance of being acquired by Firm 1. It is easy to show the following:

- *If no acquisition has taken place yet, there is no acquisition in the bad state at date 1.*

- *If no acquisition has taken place yet, Firm 2 and Firm 3 do not acquire any other firm in the good state at date 1. Firm 1 always acquires Firm 2 in the good state at date 1.*

Note that Firm 1 acquires the largest remaining firm in the good state at date 1, since this is most profitable. If no acquisition has occurred yet, the largest remaining firm it can acquire is Firm 2. Now we turn to date 0. Does Firm 3, the last firm to move at date 0, acquire Firm 4? We can show, following the calculations in the main text before Proposition 3:

- *If no acquisition has taken place yet, Firm 3 acquires Firm 4 at date 0 if and only if* $w < 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)C_4$.

Does Firm 2, which moves before Firm 3, acquire any other firm at date 0? We separate the remainder of the proof into two cases. First consider CASE 1:

$$w < 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)C_4. \tag{A2}$$

We can show, following the calculations in the main text before Proposition 3:

- *If no acquisition has taken place yet and if* $w < 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)$ C_4*, Firm 2 always acquires Firm 4 at date 0.*

Firm 1 moves before Firm 2 at date 0. It is easy to show the following:

- *If no acquisition has taken place yet and if* $w < 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)$ C_4*, Firm 1 does not acquire any other firm at date 0.*

Now we consider CASE 2:

$$w \geq 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)C_4. \tag{A3}$$

Note that there are, as in CASE 1, no acquisitions in the bad state at date 1 and the conditions under which acquisitions occur in the good state at date 1 and under which Firm 3 acquires Firm 4 at date 0 are the same as in CASE 1.

We can show (for Firm 2, following the calculations in the main text before Proposition 3):

- *If no acquisition has taken place yet and if* $w \geq 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)$ C_4*, Firm 1 and Firm 2 do not acquire any other firm at date 0.*

To complete the proof of Proposition 3, we have to calculate which acquisition occurs first from the firms' behavior summarized in the italicized statements. It is easy to verify (keeping in mind that Firm 1 moves first, Firm 2 second, and Firm 3 last at each date) that the first acquisition in all parameter regions as described in Proposition 3 is the unique first equilibrium acquisition. This can be done using the summary of the italicized statements provided in Table AI, as described in the general remarks about the proofs before the precise statement of Proposition 2.

Note that after Firm 2 acquires Firm 4 at date 0, Firm 1 acquires the combination of Firms 2 and 4 in the good state at date 1. Note also that all acquisitions

by Firm 1 are profitable. Moreover, Firm 2's acquisition of Firm 4 is also profitable. If Firm 2 acquires Firm 4 at date 0, Firm 2 pays

$$C_4 + 0.5(1/\alpha)(w + (1-\rho)(w - \alpha C_4) + \rho\alpha 0.5(C_2 + C_4) - 2w), \tag{A4}$$

as can be seen from the condition under which Firm 2 acquires Firm 4 at date 0, $w + (1-\rho)(w - \alpha C_4) + \rho\alpha 0.5(C_2 + C_4) > 2w$ (see Section II of the paper). Hence, the change in Firm 2's value due to the acquisition (that is, the postacquisition value minus the stand-alone value) is

$$\begin{aligned} &-(1-\rho)C_4 + 0.5\rho(C_2 + C_4) - 0.5(1/\alpha) \\ &\quad \times (w + (1-\rho)(w - \alpha C_4) + \rho\alpha 0.5(C_2 + C_4) - 2w). \end{aligned} \tag{A5}$$

This can be simplified to $-0.5(1-\rho)C_4 + 0.25\rho(C_2 + C_4) + 0.5w\rho/\alpha$. The acquisition occurs for $w < 0.5\alpha(C_3 + C_4) - \alpha((1-\rho)/\rho)C_4$. One can write this condition as $-0.5(1-\rho)C_4 + 0.25\rho(C_3 + C_4) - 0.5w\rho/\alpha > 0$. This implies that

$$-0.5(1-\rho)C_4 + 0.25\rho(C_2 + C_4) + 0.5w\rho/\alpha > 0. \tag{A6}$$

The precise statement of Proposition 4 is:

PROPOSITION 4: *If $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5)$, then Firm 4 acquires Firm 5 at date 0. Then Firm 1 acquires the combination of Firms 4 and 5 in the good state at date 1. Both acquisitions are profitable. If*

$$w \in [-\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5), -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_3 + C_5)), \tag{A7}$$

then Firm 3 acquires Firm 5 at date 0. Then Firm 1 acquires the combination of Firms 3 and 5 in the good state at date 1. Both acquisitions are profitable. If

$$w \in [-\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_3 + C_5), 0.5\alpha(C_4 + C_5)), \tag{A8}$$

then Firm 4 acquires Firm 5 in the good state at date 1. Then Firm 1 acquires the combination of Firms 4 and 5 in the good state at date 1. Both acquisitions are profitable. If $w \in [0.5\alpha(C_4 + C_5), 0.5\alpha(C_3 + C_5)]$, then Firm 3 acquires Firm 5 in the good state at date 1. Then Firm 1 acquires the combination of Firms 3 and 5 in the good state at date 1. Both acquisitions are profitable. In all parameter regions except where

$$-4\alpha((1-\rho)/\rho)C_5 + \alpha(C_4 + C_5) + 0.5\alpha C_3 > 0.5\alpha(C_3 + C_5) \tag{A9}$$

holds,

$$0.5\alpha C_3 + \alpha(C_4 + C_5) \leq 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5 \tag{A10}$$

does not hold,

$$0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5 < 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4 \tag{A11}$$

holds, and

$$w \in (0.5\alpha(C_3 + C_5), -4\alpha((1-\rho)/\rho)C_5 + \alpha(C_4 + C_5) + 0.5\alpha C_3) \tag{A12}$$

holds, if $w \in (0.5\alpha(C_3 + C_5), 0.5\alpha C_3 + \alpha(C_4 + C_5))$*, Firm 4 acquires Firm 5 in the good state at date 1. Then Firm 1 acquires the combination of Firms 4 and 5 in the good state at date 1. Both acquisitions are profitable. If (A9) holds, (A10) does not hold, (A11) holds, and*

$$w \in (0.5\alpha(C_3 + C_5), -4\alpha((1-\rho)/\rho)C_5 + \alpha(C_4 + C_5) + 0.5\alpha C_3), \tag{A13}$$

then Firm 4 acquires Firm 5 at date 0. Then Firm 1 acquires the combination of Firms 4 and 5 in the good state at date 1. Both acquisitions are profitable. In all parameter regions except where (A9) does not hold and (A10) holds, if

$$w \in [0.5\alpha C_3 + \alpha(C_4 + C_5), 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4], \tag{A14}$$

then Firm 2 acquires Firm 5 at date 0. Then Firm 3 acquires Firm 4 in the good state at date 1. Both acquisitions are unprofitable. If (A9) does not hold, (A10) holds, (A11) does not hold, and

$$w \in [0.5\alpha C_3 + \alpha(C_4 + C_5), 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4], \tag{A15}$$

Firm 3 acquires Firm 4 in the good state at date 1. Then Firm 2 acquires Firm 5 in the good state at date 1. Both acquisitions are unprofitable. If (A9) does not hold, (A10) and (A11) hold, and

$$w \in [0.5\alpha C_3 + \alpha(C_4 + C_5), 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5], \tag{A16}$$

then Firm 3 acquires Firm 4 in the good state at date 1. Then Firm 2 acquires Firm 5 in the good state at date 1. Both acquisitions are unprofitable. If (A9) does not hold, (A10) and (A11) hold, and

$$w \in (0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5, 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4], \tag{A17}$$

then Firm 2 acquires Firm 5 at date 0. Then Firm 3 acquires Firm 4 in the good state at date 1. Both acquisitions are unprofitable. If $w > 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4$*, Firm 4 acquires Firm 5 at date 0. This acquisition is unprofitable. Then Firm 1 acquires the combination of Firms 4 and 5 in the good state at date 1. This acquisition is profitable.*

Proof of Proposition 4: As always, we solve the model by backward induction. It is easy to show the following:

- *If no acquisition has taken place yet, there is no acquisition in the bad state at date 1.*
- *If no acquisition has taken place yet, Firm 1 always acquires Firm 2 in the good state at date 1.*
- *If no acquisition has taken place yet, Firm 2 acquires Firm 5 in the good state at date 1 if and only if* $w > 0.5\alpha C_2$.

Note that Firm 1 acquires the largest remaining firm in the good state at date 1, since this is most profitable. If no acquisition has occurred yet, the largest remaining firm it can acquire is Firm 2. It is easy to show that Firm 2 would like to acquire Firm 3, Firm 4, and Firm 5 in the good state at date 1 if and only

if $w > 0.5\alpha C_2$ and that its manager is indifferent between the target firms. By assumption, Firm 2 resolves this indifference in favor of acquiring the smallest firm, Firm 5.

Does Firm 3, which moves before Firm 2, acquire any other firm in the good state at date 1? We can show:

- *If no acquisition has taken place yet, Firm 3 acquires Firm 5 in the good state at date 1 if and only if* $w \leq 0.5\alpha(C_3 + C_5)$. *Firm 3 acquires Firm 4 in the good state at date 1 if and only if* $w > 0.5\alpha(C_3 + C_5)$.

If Firm 3 acquires Firm 5, it becomes the second-largest firm and is acquired by Firm 1. Its manager receives up to $0.5\alpha(C_3 + C_5)$. If Firm 3 does not acquire Firm 5, two situations can arise. First, if $w \leq 0.5\alpha C_2$, Firm 1 acquires Firm 2 and Firm 3's manager receives w. Hence, Firm 3 acquires Firm 5 if and only if $0.5\alpha(C_3 + C_5) > w$. As a consequence, Firm 3 acquires Firm 5 whenever $w \leq 0.5\alpha C_2$. Second, if $w > 0.5\alpha C_2$, Firm 2 acquires Firm 5 if Firm 3 does not acquire Firm 5. Then Firm 1 acquires Firm 3 and Firm 3's manager receives $0.5\alpha C_3 < 0.5\alpha(C_3 + C_5)$. Hence, Firm 3 would like to acquire Firm 5 whenever $w > 0.5\alpha C_2$. It is also easy to show under which conditions Firm 3 would like to acquire Firm 4 and that Firm 3 prefers to acquire Firm 5 rather than Firm 4 if and only if $w \leq 0.5\alpha(C_3 + C_5)$.

Does Firm 4, which moves before Firm 3, acquire Firm 5 in the good state at date 1? We can show:

- *If no acquisition has taken place yet, Firm 4 acquires Firm 5 in the good state at date 1 if and only if* $w < 0.5\alpha(C_4 + C_5)$ *or* $w \in (0.5\alpha(C_3 + C_5), 0.5\alpha C_3 + \alpha(C_4 + C_5))$.

Now let us turn to date 0. It is easy to show the following:

- *If no acquisition has taken place yet, Firm 1 does not acquire any other firm at date 0.*

We separate the remainder of the proof into two cases. First, we consider CASE 1:

$$w < 0.5\alpha C_3 + \alpha(C_4 + C_5). \tag{A18}$$

Does Firm 2, which moves before Firm 1, acquire any other firm at date 0? We can show:

- *If no acquisition has taken place yet and if* $w < 0.5\alpha C_3 + \alpha(C_4 + C_5)$, *Firm 2 does not acquire any other firm at date 0.*

If Firm 2 acquires Firm 5, it remains independent and its manager receives up to $2w - \alpha(1 - \rho)C_5$. If Firm 2 does not acquire Firm 5, several situations can arise. If $w < 0.5\alpha(C_4 + C_5)$ or $w \in (0.5\alpha(C_3 + C_5), 0.5\alpha C_3 + \alpha(C_4 + C_5))$, Firm 4 acquires Firm 5 in the good state at date 1. It is easy to show that afterward Firm 2 does not acquire Firm 3. Then Firm 1 acquires the combination of Firms 4 and 5. Hence, Firm 2 remains independent and its manager receives

$2w > 2w - \alpha(1-\rho)C_5$. Hence, Firm 2 does not acquire Firm 5 in this parameter region.

If $w \in [0.5\alpha(C_4 + C_5), 0.5\alpha(C_3 + C_5)]$, Firm 3 acquires Firm 5 in the good state at date 1 if Firm 2 does not acquire Firm 5 at date 0. It is easy to show that afterward Firm 2 does not acquire Firm 4. Then Firm 1 acquires the combination of Firms 3 and 5. Firm 2 remains independent and its manager receives $2w > 2w - \alpha(1-\rho)C_5$. Hence, Firm 2 does not acquire Firm 5 in this parameter region.

One can also show that Firm 2 does not acquire Firm 4 or Firm 3 either.

Does Firm 3, which moves before Firm 2, acquire any other firm at date 0? We can show:

- *If no acquisition has taken place yet and if $w < 0.5\alpha C_3 + \alpha(C_4 + C_5)$, Firm 3 acquires Firm 5 at date 0 if and only if $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_3 + C_5)$.*

Finally, does Firm 4, which moves before Firm 3, acquire Firm 5 at date 0? We can show:

- *If no acquisition has taken place yet and if $w < 0.5\alpha C_3 + \alpha(C_4 + C_5)$, Firm 4 acquires Firm 5 at date 0 if and only if $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5)$ holds or both $w \in (0.5\alpha(C_3 + C_5), 0.5\alpha C_3 + \alpha(C_4 + C_5))$ and*

$$w < -4\alpha((1-\rho)/\rho)C_5 + \alpha(C_4 + C_5) + 0.5\alpha C_3 \tag{A19}$$

hold.

If Firm 4 acquires Firm 5 at date 0, Firm 1 acquires the combination of Firms 4 and 5 in the good state at date 1. Hence, Firm 4's manager receives an expected payoff at date 0 of up to $w + (1-\rho)(w - \alpha C_5) + 0.5\rho\alpha(C_4 + C_5)$. If Firm 4 does not acquire Firm 5 at date 0, several situations can arise.

If $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_3 + C_5)$ or $w \in [0.5\alpha(C_4 + C_5), 0.5\alpha(C_3 + C_5)]$, Firm 3 acquires Firm 5 at date 0 or in the good state at date 1 if Firm 4 does not acquire Firm 5 at date 0. It is easy to show that afterward Firm 2 does not acquire Firm 4. Then Firm 1 acquires the combination of Firms 3 and 5 in the good state at date 1. Firm 4 remains independent. Hence, Firm 4 acquires Firm 5 at date 0 if and only if $w + (1-\rho)(w - \alpha C_5) + 0.5\rho\alpha(C_4 + C_5) > 2w$, that is, $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5)$ (and never if $w \in [0.5\alpha(C_4 + C_5), 0.5\alpha(C_3 + C_5)]$).

If $w \in [-\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_3 + C_5), 0.5\alpha(C_4 + C_5))$, Firm 4 acquires Firm 5 in the good state at date 1 for $C_5 + 0.5(1/\alpha)(0.5\alpha(C_4 + C_5) - w)$ and then Firm 1 acquires the combination of Firms 4 and 5 if Firm 4 does not acquire Firm 5 at date 0. Hence, Firm 4 acquires Firm 5 at date 0 if and only if

$$\begin{aligned} w + (1-\rho)(w - \alpha C_5) + 0.5\rho\alpha(C_4 + C_5) > w + (1-\rho)w \\ + \rho(0.25\alpha(C_4 + C_5) + 0.5w), \end{aligned} \tag{A20}$$

that is, $w < -2\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5)$. But this is never satisfied in the parameter region we are considering, and hence in this parameter region Firm 4 does not acquire Firm 5 at date 0.

If $w \in (0.5\alpha(C_3 + C_5), 0.5\alpha C_3 + \alpha(C_4 + C_5))$ and Firm 4 does not acquire Firm 5 at date 0, Firm 4 acquires Firm 5 in the good state at date 1 for, as one can show, $C_5 + 0.5(1/\alpha)(0.5\alpha(C_4 + C_5) - 0.5(w - 0.5\alpha C_3))$ and then Firm 1 acquires the combination of Firms 4 and 5. Hence, Firm 4 acquires Firm 5 at date 0 if and only if

$$\begin{aligned} w + (1-\rho)(w - \alpha C_5) + 0.5\rho\alpha(C_4 + C_5) > w + (1-\rho)w \\ + \rho(0.25\alpha(C_4 + C_5) + 0.25w - 0.125\alpha C_3), \end{aligned} \tag{A21}$$

that is, as can be seen after some algebraic transformation,

$$w < -4\alpha((1-\rho)/\rho)C_5 + \alpha(C_4 + C_5) + 0.5\alpha C_3. \tag{A22}$$

Now let us turn to CASE 2:

$$w \geq 0.5\alpha C_3 + \alpha(C_4 + C_5). \tag{A23}$$

Under which conditions do Firms 2, 3, and 4 make acquisitions at date 0? Recall that the conditions under which acquisitions occur at date 1 and Firm 1 makes acquisitions at date 0 are the same as in CASE 1.

Does Firm 2, which moves before Firm 1, acquire any other firm at date 0? One can show that Firm 2 acquires Firm 5 at date 0 if and only if $w \geq 0.5\alpha C_3 + \alpha(C_4 + C_5)$ and at the same time $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$. Hence, there are two cases to consider. First assume that

$$0.5\alpha C_3 + \alpha(C_4 + C_5) \leq 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5 \tag{A24}$$

(Case A). Case B is discussed below. Then the following is true:

- *If no acquisition has taken place yet and if $w \geq 0.5\alpha C_3 + \alpha(C_4 + C_5)$ and (A24) holds, Firm 2 acquires Firm 5 at date 0 if and only if $w > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5$.*

Does Firm 3, which moves before Firm 2, acquire any other firm at date 0? We can show:

- *If no acquisition has taken place yet and if $w \geq 0.5\alpha C_3 + \alpha(C_4 + C_5)$ and (A24) holds, Firm 3 acquires Firm 4 at date 0 if and only if $w > 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4$.*

Finally, does Firm 4, which moves before Firm 3, acquire Firm 5 at date 0? We can show:

- *If no acquisition has taken place yet and if $w \geq 0.5\alpha C_3 + \alpha(C_4 + C_5)$ and (A24) holds, Firm 4 acquires Firm 5 at date 0 if and only if $w > 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4$.*

Now consider Case B:

$$0.5\alpha C_3 + \alpha(C_4 + C_5) > 0.5\alpha C_2 + 2\alpha((1-\rho)/\rho)C_5. \tag{A25}$$

We know from the discussion above that the following is true:

- *If no acquisition has taken place yet and if* $w \geq 0.5\alpha C_3 + \alpha(C_4 + C_5)$ *and (A25) holds, Firm 2 always acquires Firm 5 at date 0.*

One can also show that in this case the conditions under which Firm 3 acquires Firm 4 or Firm 5 at date 0 and the conditions under which Firm 4 acquires Firm 5 at date 0 are the same as in Case A. To complete the proof of Proposition 4, we have to calculate which acquisition occurs first from the firms' behavior summarized in the italicized statements. One can verify (keeping in mind that Firm 4 moves first, Firm 3 second, Firm 2 third, and Firm 1 last at each date) that the first acquisition in all parameter regions as described in Proposition 4 is the unique first equilibrium acquisition. This can be done using the summary of the italicized statements provided in Table AI, as described in the general remarks about the proofs before the precise statement of Proposition 2.

It turns out that the exact equilibrium merger activity depends on whether parameter conditions (A9), (A10), and (A11) hold. Hence, there are eight possible cases to consider. One can show that only four of these cases are possible: (A9) does not hold, but (A10) and (A11) hold; (A10) does not hold, but (A9) and (A11) hold; (A11) holds but neither (A9) nor (A10) hold; and (A10) holds but neither (A9) nor (A11) hold. The other four cases are not possible. It cannot be the case that neither (A10) nor (A11) hold, because

$$0.5\alpha C_3 + \alpha(C_4 + C_5) < 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4. \tag{A26}$$

One can also show that (A9) and (A10) cannot hold together.

Note that after Firm 4 acquires Firm 5 or Firm 3 acquires Firm 5, Firm 1 acquires the combination of Firms 4 and 5 or Firms 3 and 5 in the good state at date 1. It is easy to show that after Firm 3 acquires Firm 4 in the good state at date 1, Firm 2 acquires Firm 5 in the good state at date 1. It is also easy to show that after Firm 2 acquires Firm 5 at date 0, Firm 3 acquires Firm 4 in the good state at date 1.

Note also that if Firm 3 acquires Firm 5 or Firm 4 acquires Firm 5 at date 0 or at date 1, this acquisition is profitable, except the acquisition of Firm 5 by Firm 4 at date 0 if $w > 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4$.

For example, consider the acquisition of Firm 5 by Firm 4 at date 0 if $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5)$. The change in Firm 4's value due to the acquisition of Firm 5 (the postacquisition value minus the stand-alone value) is

$$-(1-\rho)C_5 + 0.5\rho(C_4 + C_5) - 0.5(1/\alpha)(w + (1-\rho)(w - \alpha C_5) + 0.5\rho\alpha(C_4 + C_5) - 2w). \tag{A27}$$

This expression can be simplified to $-0.5(1-\rho)C_5 + 0.25\rho(C_4 + C_5) + 0.5\rho w/\alpha$. The condition under which this acquisition occurs, $w < -\alpha((1-\rho)/\rho)C_5 + 0.5\alpha(C_4 + C_5)$, implies that

$$-0.5(1-\rho)C_5 + 0.25\rho(C_4 + C_5) - 0.5\rho w/\alpha > 0. \tag{A28}$$

But this implies that the change in Firm 4's value due to the acquisition is positive. However, one can show that the acquisition of Firm 5 by Firm 4 at date 0 if $w > 0.5\alpha C_3 + 2\alpha((1-\rho)/\rho)C_4$ is unprofitable. The acquisitions of Firm 5 by Firm 2 (at date 0 or at date 1) and Firm 4 by Firm 3 (at date 1) are unprofitable, because they create negative synergies (date 0 acquisitions) or zero synergies (date 1 acquisitions) but involve a positive premium. Finally, clearly, all acquisitions by Firm 1 are profitable.

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