



Federal Reserve Bank of Chicago

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

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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 and a regime shift that may lead to some value-increasing merger opportunities. Anticipation of the regime shift can lead to mergers, either for defensive or positioning reasons. Defensive mergers occur when managers acquire other firms to avoid being acquired themselves. Mergers may also allow a firm to position itself as a more attractive takeover target and earn a takeover premium. The identity of acquirers and targets and the profitability of acquisitions depend, among other factors, on the distribution of firm sizes within an industry.

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## Introduction

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, expanding from \$800 billion in 1995 to \$1.8 trillion in 2000.<sup>1</sup> Due to the growth and importance of mergers, a substantial academic literature has developed to examine them. However, existing 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.<sup>2</sup> 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 et al. (2004) and Kahl and Rosen (2002)). Second, mergers concentrate in industries that have experienced regime shifts in technology or regulation. Mergers may provide an efficient strategy for managers coping with such a shift and seeking to maximize the value of their firms (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 (2002)) - can explain the second stylized fact. However, it has difficulties explaining negative abnormal returns to acquirers. Theories based on managerial self-interest or a desire for larger firm size and diversification (for example, Morck, Shleifer, and Vishny (1990)) can explain negative acquirer returns.<sup>3</sup> However, they cannot explain why mergers are concentrated in industries undergoing a regime shift.

This paper provides a theory of mergers that combines elements from both of these schools

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<sup>1</sup> See “The Year of the Mega Merger...”, *Fortune Magazine*, January 11, 1999, “Tales of the Tape: '99 M&A Vol Hits Record...”, *Dow Jones News Service*, December 29, 1999, and “Year-End Review of Markets & Finance 2000..”, *The Wall Street Journal*, January 2, 2001.

<sup>2</sup> Studies that find negative average returns to bidders include Asquith, Bruner, and Mullins (1987), Banerjee and Owers (1992), Bradley, Desai, and Kim (1988), Byrd and Hickman (1992), Jennings and Mazzeo (1991), Servaes (1991), Varaiya and Ferris (1987), and You, Caves, Smith, and Henry (1986). See Table 8-6 in Gilson and Black (1995). See also the recent survey by Andrade, Mitchell, and Stafford (2001). 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.

<sup>3</sup> Other papers in which managerial motivations for mergers are prominent include Amihud and Lev (1981), Shleifer and Vishny (1989), and May (1995). Theoretical papers representing the neoclassical tradition include Gort (1969) and Rubin (1973). Negative acquirer announcement returns can be explained without appealing to agency conflicts between managers and owners if the takeover announcement reveals negative information about the acquirer's profitability relative to expectations (see McCardle and Viswanathan (1994) and Jovanovic and Braguinsky (2004)).

of thought. The notion of a regime shift that *may* make mergers an efficient choice for managers remains a key part of our analysis. However, one particular managerial motive – the desire not to be acquired – is also important. Our theory of mergers is able to reconcile the above two stylized facts and also explain a third important characteristic of mergers – the fact that they often come in waves. Firm size plays a key role in our theory, which can help explain the differing findings on acquirer returns for small and large firms.

The basic elements of our theory are the following: First, we assume that managers derive a private benefit 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 managers of acquired firms may lose private benefits because they are likely to either play subordinated roles in the new firms or lose their jobs (Morck, Shleifer, and Vishny (1988)).

Second, we assume that there is the possibility of a regime change that creates economies of scale (synergies). After the regime shift, some mergers create value, and larger targets are 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 regime shift is uncertain. *Ex ante*, the probability of the regime shift is small enough that mergers do not create 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 will be 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 the probability of being a target is decreasing in firm size (e.g., see Hasbrouck (1985) and Palepu (1986)).

In our model, 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 itself as it becomes bigger than some rivals. This defensive merger motive is self-reinforcing:

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,<sup>4</sup> in which unprofitable defensive acquisitions preempt some or all profitable acquisitions. 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 following the regime shift, merger synergies are increasing in size (due to economies of scale), by becoming larger, a firm can become a more attractive takeover target. Being acquired generates a takeover premium for the target and for its manager, who owns a share of the firm. 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 so 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, that is, private benefits are low, they may engage in acquisitions in order to position themselves as a *more* attractive target. 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 all 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 a similar size, medium-size firms have both the opportunity to make defensive acquisitions (that make them large enough to be protected from takeovers) as well as positioning acquisitions (that make them more attractive takeover targets). 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 in the acquirer's size. Large firms engage only in defensive, unprofitable acquisitions,

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<sup>4</sup> 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, "For Military Contractors, It's Buy or Be Bought", New York Times, March 12, 1994, "Phone Giants Reportedly Mulling Merger", Los Angeles Times, May 11, 1998, and "Middle-market M&A players: Where are they now?", Bank Mergers & Acquisitions, August 1, 2002). Sometimes these articles explicitly discuss the role that firm size can play in who can acquire whom (see, for example, "New England Utility Mergers Raise Question over Boston Edison's Future", KRTBN Knight-Ridder Tribune Business News: The Boston Globe – Massachusetts, June 16, 1999, and "Takeover Rumors Fuel Another Rise in Amgen Stock...", The Los Angeles Times, August 30, 1994).

and these only occur when private benefits are high.<sup>5</sup> Medium-size 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 in the size of the target relative to that of the acquirer. Finally, small firms typically engage in profitable acquisitions.<sup>6</sup> These mixed firm size industries are most likely to exhibit merger waves, because some firms have defensive as well as positioning merger motives. Which motive matters depends on their managers' interest in maximizing firm value. While the additional acquisitions may not be undertaken by medium-size firms, those firms tend to make the most acquisitions.

Overall, our models show that in industries with economies of scale, firm size becomes the driving force for merger dynamics. Often, this leads to profitable acquisitions. However, if a firm becomes 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 above. It also generates a number of other empirical predictions. For example, we predict that (1) acquirer returns are negatively correlated with acquirer size as well as target size (consistent with the results in Kahl and Rosen (2002), Moeller, Schlingemann, and Stulz (2004), and Kahl and Valkanov (2004)); (2) that acquirer announcement returns for medium-size firms decrease in the ratio of target to acquirer size; and that (3) medium-size firms are most likely to acquire other firms. However, we caution that the notion of size in our model – size relative to the largest firm in the industry with a profitable acquisition opportunity - is slightly different than absolute size. These and other empirical implications are discussed in more detail in section V.

Another implication of our model that is central to our theory is that the firm size distribution in an industry matters for merger dynamics. To our knowledge, other merger theories do not have strong predictions about how acquisitions are related to industry structure. In particular, our model predicts that firms in industries with more medium-size firms have a higher probability of making acquisitions. We use data on U.S. mergers from 1983-2003 to test this hypothesis, and we find support for it.

Our paper is related to several other papers. Harris (1994) presents a model that determines which firm is the acquirer and which firm 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 dynam-

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<sup>5</sup> 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.

<sup>6</sup> However, there is one unprofitable acquisition by a small firm for very high private benefits in our model.

ics involving several firms. This allows us to generate results on the timing of mergers, on merger waves, and on the effect of the distribution of firm sizes in an industry on the merger dynamics, the identity of acquirers and targets, and the profitability of acquisitions. Toxvaerd (2004) 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 determines the merger timing. This can give rise to strategic merger waves. Managerial acquisition incentives or the importance of size as a takeover deterrent do not play a role in the analysis.

There are a number of other important papers on mergers. Shleifer and Vishny (2003) argue that merger waves are driven by misvaluations in the stock market.<sup>7</sup> Rhodes-Kropf and Viswanathan (2004) show that even in a rational model with efficient markets stock market booms can lead to merger waves. Roll (1986) argues that acquirers may overpay because managers may fall prey to hubris.<sup>8</sup> Lambrecht (2004) and Morellec and Zhdanov (2005) emphasize the real options aspects of 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), Baker (1997), Gowrisankaran (1999), Epstein and Rubinfeld (2001), and Peters (2003)).<sup>9</sup> 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), initial industry size distribution, division of any surplus between merging entities, and so on. We also have to make strong assumptions on the merger protocol to keep our models tractable.

The remainder of the paper is structured as follows: Section I presents the basic model and an extension to merger waves in an industry with firms of similar size. Section II offers a model with a dominant firm. Section III presents a model in which some but not all firms are of similar size. Section IV discusses some of the assumptions of our models. Section V presents some addi-

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This acquisition secures the independence of the small firm for one, but not two, periods.

<sup>7</sup> For empirical evidence supporting this theory see Ang and Cheng (2003), Dong, Hirshleifer, Richardson, and Teoh (2003), 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.

<sup>8</sup> For empirical evidence supporting the hubris hypothesis, see, for example, Rau and Vermaelen (1998) and Malmendier and Tate (2003).

<sup>9</sup> These models typically cannot be solved analytically. However, Gowrisankaran and Holmes (2004) analytically analyze the effect of mergers on industry concentration.

tional empirical implications of our theory. Section VI offers a short empirical part. Section VII concludes.

## I. The Basic Model

This section 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 mergers where managers have a better chance of retaining private benefits (in our model, equivalent to keeping their jobs) at the expense of shareholder value. We call these defensive mergers. This model does not have a role for value-increasing positioning mergers, which are undertaken to increase the chance of the firm being taken over and hence earning a premium. A model of positioning mergers needs at least four firms and will be presented in the next section.

### A. Model Assumptions

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

The three firms are ordered by their size (stand-alone value)  $C_i$ , with  $C_1 > C_2 > C_3$ , so Firm 1 is the largest and Firm 3 the smallest (we always assume that firms are ordered by size, with Firm  $i$  larger than Firm  $j$  if  $i < j$ ).<sup>10</sup> We assume that firms cannot acquire firms that are larger than they are, implying that every firm is immune against acquisition attempts by firms that are smaller than it is. 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.<sup>11</sup> As a consequence of the assumption that a firm cannot acquire a larger firm, Firm 3 cannot acquire another firm, because it is the smallest firm. To make the model interesting, we assume that  $C_2 + C_3 > C_1$ , i.e., 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.

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<sup>10</sup> In interpreting our models, it should be recognized that antitrust laws put some restrictions on intra-industry 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.

<sup>11</sup> 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)).



At each date, a manager receives private benefits of  $w$  if his firm is not acquired and zero if it is acquired.<sup>12</sup> The manager of each firm also owns a share  $\alpha$  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 cannot fully overcome managerial preference for their firms to remain independent.<sup>13</sup>

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, Firm 2 moves second, and Firm 3 moves last. 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 may occur, corresponding to a change in their environment. For example, a fundamental change in technology or government regulation may at some point in the (near) future make acquisitions profitable. The change may generate economies of scale or scope, or it may lead to overcapacity. The key is that the regime shift changes conditions in the industry enough to make some acquisitions possibly profitable, but the probability of this regime shift is low enough such that current acquisitions are not yet profitable for the acquirer.

More concretely, we assume that mergers at date 1 are *possibly* efficient. Specifically, firms learn at date 0 that the state of nature at date 1 will be good with probability  $\rho$  and bad with probability  $1 - \rho$ . In the good state of the world, only Firm 1 has efficient merger opportunities 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, perhaps due to synergies (economies of scale and scope).

Without loss of generality, we assume that if the good state occurs at date 1, Firm 2 and Firm 3 are worth twice as much when combined with Firm 1 than as stand-alones: Firm 2 is worth  $C_2$

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<sup>12</sup> In reality, private benefits differ across firms and managers and arguably increase in firm size. In a model that captured 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), and Jensen (1993)).

<sup>13</sup> An assumption that the agency conflict cannot be fully eliminated through compensation contracts is typically made in the literature (see, e.g., Hart and Moore (1995)).

as a stand-alone, but is worth  $2C_2$  if combined with Firm 1. Similarly, Firm 3 is worth  $C_3$  as a stand-alone, but is worth  $2C_3$  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.<sup>14</sup>

In the bad state at date 1, all mergers destroy value. For simplicity, we assume that any target acquired by another firm is worth zero after the merger. 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), even for Firm 1 at date 0. This will be the case if the bad state is more likely than the good state:

$$(1) \rho < 0.5.$$

Firms might make unprofitable acquisitions in our model because we assume that the acquiring firm's *managers* decide whether or not to make an offer. We concentrate on the motivations to make acquisition offers, but we also have to think about when a target firm will accept an offer. Assume that *shareholders* of the target firm make the decision about whether to accept an offer.<sup>15</sup> We assume that target shareholders accept a takeover offer if and only if it involves at least a zero premium over its stand-alone value.<sup>16</sup>

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<sup>14</sup> 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.

<sup>15</sup> 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 is 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).

<sup>16</sup> This assumption simplifies the analysis considerably, because we do not have to analyze whether the target firm is interested in rejecting an offer in the hope of a better offer by the same firm or another firm later on. We conjecture that our main results are robust to relaxing this assumption.

Finally, we determine the price at which a firm can acquire another firm by applying the Nash bargaining solution to a bargaining game between the acquiring firm's manager and the target firm's shareholders. This implies that they equally share the surplus from the merger in terms of an increase in utility for the acquiring firm's manager and the premium to 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, as discussed before, if the target firm's manager could prevent a takeover, there would be no incentives to make defensive acquisitions. We ignore the acquiring firm's shareholders in the bargaining game, since we assume that it is the acquiring firm's manager, not the shareholders, who make takeover decisions. If the acquiring firm's shareholders could prevent a merger if it is not in their interests, there would be no unprofitable acquisitions.

The Nash bargaining solution implies the following characterization of the premium the acquirer pays over the stand-alone value of the target: If Firm A acquires Firm B, it pays a premium above the stand-alone value of Firm B such that Firm A's manager retains one half of his utility gain that arises from the acquisition if the premium were zero. Put differently, the premium is determined such that one half of the difference between the utility of Firm A's manager if he acquires Firm B at a zero premium and his utility if he does not acquire Firm B but subsequently behaves optimally (perhaps acquiring Firm B at a later point of time) accrues to Firm A's manager. For example, suppose Firm 1 acquires Firm 2 in the good state at date 1. Because Firm 2 is worth  $2C_2$  if combined with Firm 1 but Firm 1 pays only  $C_2$  for it if there is no premium, Firm 1 gains  $C_2$  and its manager gains  $\alpha C_2$ . If Firm 1 pays  $C_2 + 0.5 \frac{1}{\alpha} \alpha C_2 = 1.5C_2$  for Firm 2, Firm 1's manager gains  $0.5\alpha C_2$  from the acquisition, which is half of what he would gain without paying a premium. We use this price below. Of course, the premium above stand-alone value has to be nonnegative. Otherwise, Firm B's shareholders will not agree to the acquisition. Given these assumptions, an acquisition occurs whenever it is in the interest of the acquirer's manager if he offers at least a zero premium over the target's stand-alone value. Note that the outside opportunity for the acquirer as well as the target depends on the future (optimal) merger activity. 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 but Firm 3 remains independent. Hence, the premium takes into account expected merger activity.

Note also that this bargaining model implies that acquirers may pay a positive premium even though there are no (or even negative) synergies between acquirer and target. Indeed, such mergers 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 to some extent the acquiring firm's private benefits from the acquisition, via the premium. Otherwise, negative synergies mergers could not occur. More generally, unprofitable acquisitions (even if there are positive synergies) can occur only if the acquiring firm's manager pays a premium higher than the synergies and hence shares some of the private benefits he gains with the target firm's shareholders.

## B. Equilibrium Merger Activity

To find the equilibrium pattern of mergers, we solve the model by backwards induction, starting at date 1.<sup>17</sup> Firm 2 moves last (since Firm 3 has no strategic decision to make). If the realized state of nature at date 1 is bad, all acquisitions are unprofitable. Firm 2 will not acquire Firm 3 since the acquisition destroys value 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 will 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 1 will acquire the largest remaining firm, Firm 2, 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 it and its manager gains up to  $\alpha C_2$ , his share of the synergies from the merger. Hence, he pays  $1.5C_2$  for Firm 2, as noted earlier. Firm 2, because it is acquired by Firm 1, does not get to make an acquisition offer.

Now let us turn to date 0. Firm 2 can acquire Firm 3. While this merger reduces shareholder value, Firm 2's manager may want to acquire Firm 3 since this ensures that he keeps his private benefits 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, so 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  $\alpha$  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 will be 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

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<sup>17</sup> The unique subgame perfect equilibrium outcome can be found by backwards induction, because our model is a game of complete and perfect information.

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. Note that this calculation takes into account that the outside opportunity for Firm 2's manager involves being acquired by Firm 1 in the good state at date 1 at a premium. It can be calculated that Firm 2 chooses to acquire Firm 3 at date 0 if and only if:

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

Firm 1 never acquires another firm at date 0. Such an acquisition will be unprofitable.<sup>18</sup> Proposition 1 summarizes the above discussion.

**Proposition 1:** If private benefits are low enough so that (2) does not hold, Firm 1 acquires Firm 2 in the good state at date 1 in a profitable acquisition. If private benefits are high enough so that (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. It is profitable because there are positive synergies (Firm 2 is worth more if combined with Firm 1) and Firm 1 appropriates some of this gain. 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, Firm 2 is less likely to acquire Firm 3 if  $\alpha$  is larger, because then Firm 2's manager cares more about firm value.<sup>19</sup> Moreover, if the probability of the good state at date 1 is higher, the minimal 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. There are two reasons for this result. First, a date 0 acquisition becomes more attractive if the probability that such an acquisition turns out to not destroy value (the probability of the good state) increases. Second, if the probability of the good state is higher, there is a higher

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<sup>18</sup> 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 will be 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 discussed in more detail in section IV, where we conjecture what would happen if we relaxed this assumption.

<sup>19</sup> Consistent with our prediction, Lewellen, Loderer, and Rosenfeld (1985) find that managerial stock ownership has a positive impact on the quality of acquisitions managers make. Agrawal and Mandelker (1987) find that the smaller is the ownership stake of top managers (in the form of shares and options), the more likely are any mergers or sell-offs undertaken to reduce the variance of returns on the firm's assets or to

chance that Firm 2 will be acquired by Firm 1 if Firm 2 does not acquire Firm 3 at date 0. But since Firm 2's manager wants to avoid being acquired, he is more likely to be interested in acquiring Firm 3 at date 0 if his firm is more likely to be acquired otherwise.

Proposition 1 shows how managerial self-interest leads to unprofitable acquisitions. Moreover, when managers care about private benefits, there are more mergers than occur in the first-best world (with no managerial merger motives). This is because managers do not just acquire when they are otherwise certain to be acquired, but they also acquire even if there is a significant chance of being acquired in the future. In our model, the expected number of efficient mergers is  $\rho$ , while the actual number for sufficiently high private benefits is one.

Note that the premium over stand-alone value that is paid by Firm 2 in the date 0 acquisition of Firm 3 ( $0.5 \frac{1}{\alpha} (\rho w - \alpha(1 - \rho)C_3 - 0.5\rho\alpha C_2)$ ) can be higher than the premium over stand-alone value that Firm 1 pays for Firm 2 in the good state at date 1, even though the latter is an efficient, value-creating merger while the former is value-destroying. The reason is that when Firm 2 acquires Firm 3, Firm 3 extracts some of the private benefits that Firm 2's manager preserves through the acquisition. However, the premium that Firm 1 pays for Firm 2 does not involve any private benefits, since the merger is not motivated by the preservation of any private benefits. Hence, if private benefits are sufficiently high, the inefficient acquisition of Firm 3 by Firm 2 can be associated with a larger premium. This is despite the fact that the premium that Firm 2 pays for Firm 3 at date 0 takes into account that in the absence of this acquisition Firm 2 is acquired by Firm 3 in the good state at date 1 at a positive premium – reducing the premium Firm 2 pays for Firm 3.

### C. 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. Merger synergies are similar to those in the three-firm model. In the good state at date 1, if Firm  $j$  is combined with Firm 1, its value is  $2C_j$  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, because this generates defensive merger motives for all

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reduce its leverage – goals that are in the managers', but not the shareholders' interests.

other firms. Since firms that are larger than the largest firm with a profitable acquisition opportunity never participate in any merger, we can ignore such firms. Hence, giving Firm 1 the profitable acquisition opportunity is without loss of generality. As before, we assume that any firm that is acquired is worth zero in the bad state at date 1 and that each firm can at each date make only one acquisition offer to another firm (and, again, make only one acquisition in total over both dates). So, our assumptions mean that the efficient number of mergers is one and the maximum number of mergers is two.

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 homogeneous firm size industry. Further, 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 has no strategic decisions to make). We reverse the order of moves relative to the three-firm model in the previous section, because this makes the intuition behind merger waves richer. However, if we assumed the opposite (original) order of moves, we would get similar results – and in particular, we would also get defensive merger waves.

### C.1. Analysis

Proposition 2 summarizes the merger activity for all parameter regions.<sup>20</sup> The following condition plays an important role:

$$(3) \quad w \leq 0.5\alpha C_2$$

**Proposition 2:** If private benefits are low enough so that (3) holds there is only one acquisition: Firm 1 acquires Firm 2 in the good state at date 1. This acquisition is profitable. If private benefits are high enough so that (3) does not hold, there are two acquisitions and both of them are unprofitable: Firm 4 acquires Firm 5 and Firm 2 acquires Firm 3. 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, the only merger is the most efficient one between Firm 1 and Firm 2. No firm engages in a defensive acquisition because it is unprofit-

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<sup>20</sup> All proofs, including for Proposition 2, are available from the authors upon request.

able and it also eliminates the chance of earning a takeover premium. 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, meaning that the efficient and profitable acquisition is preempted. 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.

The intuition behind the merger wave is as follows. If no merger has occurred yet, Firm 1 acquires Firm 2 in the good state at date 1. Anticipating that, Firm 2 wants to acquire Firm 5 in the good state at date 1. This means that Firms 3 and 4 also want to acquire Firm 5 in the good state at date 1 to avoid being the largest remaining firm except Firm 1, and hence the most attractive target for Firm 1. But Firm 2 anticipates that and wants to preempt them by acquiring Firm 5 at date 0<sup>21</sup>, leading Firm 3 and Firm 4 to have a similar incentive.<sup>22</sup> Given the order of moves, Firm 4 acquires Firm 5. 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 lower and hence total value destruction for the acquirer and the target combined is higher.<sup>23</sup> However, early acquisitions (at date 0) can be more profitable for the acquirer than late (date 1) acquisitions.<sup>24</sup> For example, if Firm 4 acquires Firm 5 at date 0 and then Firm 2 acquires Firm 3 at date 1, the first acquisition can be more profitable than the second. Although synergies are lower (because negative) in the first merger, Firm 2 may pay a higher premium in the date 1 acquisition than Firm 4 in the date 0 acquisition. 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

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<sup>21</sup> If it did not acquire Firm 5 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.

<sup>22</sup> If Firm 3 did not acquire Firm 5, it could still acquire Firm 4 after Firm 2 acquired Firm 5, but this turns out to be less attractive.

<sup>23</sup> 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 from Firm 2 is the difference between its manager's utility if he acquires Firm 3 at date 0 as compared to date 1. Since both acquisitions secure Firm 2's independence, Firm 3 cannot extract the private benefits in a date 0 acquisition.

<sup>24</sup> The profitability of an acquisition is calculated as the change in the acquirer's payoffs arising from the acquisition divided by the acquirer's stand-alone value.



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.

## II. Positioning Mergers: A Model with a Dominant Firm

In the previous section we analyzed the merger dynamics in a situation in which all firms were of similar size so that even if the smallest two of the five firms merged, they became larger than the largest firm. We showed 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. We present again the simplest model that generates the basic insights. For this purpose, a model with four firms suffices.

### A. The Model

Assume 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 a 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. The order of moves is as in the basic model with three firms. At each date, Firm 1 moves first, Firm 2 second, and Firm 3 last (since Firm 4 has no strategic decision to make). Merger synergies are as in the previous two models, with only acquisitions by Firm 1 in the good state of date 1 having positive synergies and all mergers in the bad state at date 1 having negative synergies.<sup>25</sup>

### B. Analysis

As in the previous section, we solve the model by backwards induction. In the bad state at date 1, there is no acquisition. Firm 1 does not acquire any other firm, and no other firm has an incentive to make an acquisition either. In the good state at date 1, Firm 1 acquires the largest

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<sup>25</sup> 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, 3, or 4). 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 slightly 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.

remaining firm. If no acquisition has yet occurred, Firm 1 acquires Firm 2. Firm 3 has no reason to acquire Firm 4 afterwards, and hence remains passive.

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 Firm 3 in the good state at date 1 after Firm 3 has acquired Firm 4. 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. 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  $w + (1 - \rho)(w - \alpha C_4) + \rho \alpha 0.5(C_3 + C_4) > 2w$  or:

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

Firm 2 moves before Firm 3 at date 0. If Firm 2 acquires Firm 4 at date 0, it ensures that it is 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 if Firm 2 does not acquire Firm 4. In this case, Firm 2 remains 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, Firm 2 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 private benefits are low enough so that (4) holds, there are two profitable acquisitions: 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. If private benefits are high enough so that (4) does not hold, there is one profitable acquisition: Firm 1 acquires Firm 2 in the good state at date 1.

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 in order to ensure that it is 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. The model in this section has no defensive acquisitions because no firm can use an acquisition to become larger than Firm 1. Instead, firms make acquisitions in order to become the second largest firm or remain the second largest firm so that they are the most attractive target for Firm 1 and can earn a takeover premium. Of course, managers engage in these positioning acquisitions to make their firms more attractive targets only if they care sufficiently strongly about firm value and less about the private benefits of control. This explains why they engage in acquisitions if private benefits are low 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 acquisition in the previous model - is a positive NPV acquisition for Firm 2. Firm 2 engages in this acquisition only if the 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 the world ( $(1-\rho)C_4$ ). This is implied by condition (4), as can be seen after some algebraic manipulation.<sup>26</sup>

### III. A Model of an Industry in which Some but Not All Firms Are of Similar Size

In section I, we presented two models that analyzed homogenous firm size industries and introduced defensive mergers, which are prominent in such industries. This arises because in these models, all firms were of similar size. For example, in section I.C., even if Firm 4 acquired Firm

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<sup>26</sup> As in the previous model, it is not clear whether date 0 or date 1 acquisitions are more profitable. For example, if Firm 2 acquires Firm 4 at date 0 and then Firm 1 acquires the combination of Firms 2 and 4 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 if private benefits are fairly high and the good state of the world is sufficiently high, because the premium Firm 2 pays for Firm 4 decreases in private benefits and the probability of the good state. The reason is that this acquisition will lead to a loss of control of Firm 2's manager in the good state at date 1. In contrast, Firm 1's acquisition premium for the combination of Firms 2 and 4 is not a function of private benefits, since Firm 1's manager stays in control with or without an acquisition.

5, it became larger than Firm 1. Hence, all acquisitions (except by Firm 1) had defensive value. In section II, we analyzed heterogeneous firm size industries and introduced positioning mergers, which are prominent in such industries. The reason was that the largest firm was much larger than all other firms. Even if Firm 2 acquired Firm 3, it was still smaller than Firm 1. Hence, no acquisition could have defensive value. However, acquiring another firm made the combined firm more attractive as a target to the largest firm.

In this section, we present a model in which some firms are of similar size but others much smaller than the largest firm. We refer to this type of industry as a mixed firm size industry. The model in this section analyzes the equilibrium merger dynamics in mixed firm size industries. We show that the merger dynamics are yet again different. Both defensive and positioning mergers can occur, depending on the level of private benefits. The mixed firm size industry is arguably the richest (and perhaps most realistic) industry structure and 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 mergers). However, the previous models in sections I and II are not special cases of this model. They 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 so 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 so 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. 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 may increase 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”, and “small” firms. In contrast, in the two models in section I, all firms 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 Appendix A, 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 3 acquires Firm 4 and Firm 2 acquires Firm 5, either at date 0 or 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. For high enough private benefits, this acquisition is unprofitable. Then Firm 1 acquires the combined company 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 do negative NPV acquisitions, while small firms (Firm 4) tend do to 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 have no possibility to 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 deter being 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 Appendix A, 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 the highest realization of the private benefits of control, this acquisition can be unprofitable.<sup>27</sup> Medium-size firms (Firm 3) can and may have an incentive to do either defensive or positioning acquisitions. Hence, they sometimes make profitable and sometimes unprofitable acquisitions.

The Proposition also shows that larger acquisitions tend to be less profitable than smaller acquisitions. 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).<sup>28</sup> The intuition is that a large acquisition is more likely to be motivated by defensives motives (since it makes the acquirer much larger and hence more likely to be larger than Firm 1) while a small acquisition has less defensive, but more positioning, value.

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<sup>27</sup> While Firm 4 is too small to protect its independence for two periods, this acquisition secures its independence for one period, and Firm 4's manager is willing to overpay for Firm 5 for this reason.

<sup>28</sup> This can be seen more clearly from the exact formulation of Proposition 4 in the Appendix.

The insight that acquirer size affects the profitability of acquisitions is already suggested by a comparison of Propositions 2 and 3. Proposition 2 showed that in a model with only large acquirers, all acquisitions (except by the largest firm) are negative NPV acquisitions. However, it was not clear that these results were driven by acquirer size alone. In particular, all targets as well as acquirers were “large” in the model in section I.C. that leads to Proposition 2. Hence, the unprofitable acquisitions might be driven by target size instead of acquirer size. In that model, it would be impossible to disentangle the effects of target size and of acquirer size. Proposition 3 showed that in a model with only small acquirers (except Firm 1), these firms made only positive NPV acquisitions. That model cannot say anything about the importance of target size since small firms can only acquire even smaller firms.

In the model of this section, we can distinguish between the effect of acquirer and target size. Large acquirers make unprofitable acquisitions. Clearly, this is not driven by target size, since even the acquisition of small firms is unprofitable. Moreover, the profitability of the acquisitions by medium-size firms depends on the target size, emphasizing the importance of deal size.

Medium-size firms (Firm 3) have the choice between making a defensive acquisition (acquiring Firm 4) and making an acquisition to make them an attractive target for Firm 1 (by acquiring Firm 5). For low private benefits, Firm 3 acquires Firm 5 to become a more attractive target and hence earn a premium from Firm 1. For high private benefits, Firm 3 acquires Firm 4 to defend itself against being acquired by Firm 1. Hence, for a firm with the opportunity to engage in defensive as well as non-defensive acquisitions, the NPV of the acquisition is decreasing in the ratio of the target’s to the acquirer’s size. In particular, if Firm 3 acquires a small firm (Firm 5), it engages in a positive NPV acquisition. However, if Firm 3 acquires a larger firm (Firm 4), it engages in a negative NPV acquisition. This is because the acquisition of Firm 4 has defensive value while the acquisition of Firm 5 does not.

As a consequence of the effects of acquirer and target size, the combination of acquirer and target size tends to be larger for high private benefits and hence in negative NPV acquisitions: if Firm 2 acquires Firm 5 or Firm 3 acquires Firm 4 – so that the combined company is larger than Firm 1.<sup>29</sup> In contrast, for small private benefits, the acquirer tends to be smaller and the sum of acquirer and target size smaller than the size of Firm 1. Proposition 4 shows also that for high private benefits, there is a tendency for larger firms to be the acquirer.<sup>30</sup> In particular, Firm 2 makes acquisitions for high private benefits only.

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<sup>29</sup> Again, the exception is the acquisition of Firm 5 by Firm 4 for very high private benefits.

<sup>30</sup> This is true again with the exception of very high private benefits, in which Firm 4 is the acquirer.

Moreover, there are always two mergers, unlike in the previous models. Hence, mixed firm size industries are most likely to generate merger waves. With this industry structure, some firms have defensive merger opportunities while other firms cannot defend themselves. If private benefits are low, firms without defensive merger opportunities (or firms that have the opportunity to engage in defensive as well as other acquisitions) want to acquire other firms to become larger and hence an attractive target for Firm 1. One of them eventually is acquired by Firm 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. This prevents Firm 1 from acquiring any firm. Thus, for both low and high private benefits, two mergers occur. Finally, the Proposition shows that medium-size firms are the most likely to make acquisitions since they can have both defensive and positioning motives. In particular, Firm 3 engages in acquisitions both for low and high private benefits.<sup>31</sup> A different inclination to make acquisitions for firms of different size, of course, could not be shown in the previous models, since there were only firms (with the exception of Firm 1) that were of very similar size.<sup>32</sup>

#### **IV. Discussion of Assumptions and Model Features**

In this section, we discuss some of the assumptions and key model features, including implications on how to relate the model to the empirical evidence.

##### **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 market (equity) value of the firms. For example, the anticipation of Firm 4's acquisition of Firm 5 in the model in section I.C. should be reflected in the market values of both firms already at date 0. Firm 4's value before the acquisition should be lower than  $C_4$  because it will engage in a negative NPV acquisition. Firm 5's value should be higher than  $C_5$  because it will

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<sup>31</sup> Firm 4 typically makes acquisitions only for low private benefits. But it acquires Firm 5 if private benefits are very high in the exceptional parameter region discussed before.

<sup>32</sup> 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. For example, if Firms 3 or 4 acquires Firm 5 at date 0, this is always less profitable than Firm 1's acquisition of the combined company at date 1. However, if Firm 2 acquires Firm 5 at date 0 and then Firm 3 acquires Firm 4 at date 1, the early acquisition is always more profitable. This again is related to the fact that the latter acquisition pays for the private benefits that Firm 3's manager receives from the acquisition for sure (since it ensures his staying in control) while the earlier acquisition only pays for Firm 2's manager's staying in control in the good state of the world.

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 4 may not be able to acquire Firm 5 since its market value (but not its stand-alone value) may be smaller than Firm 5's. We have checked the robustness of our results to these modeling issues for the three-firm and the four-firm model. 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. However, we have not been able to do the same robustness analysis for the two five-firm models, since the models become exceedingly complicated once all mergers are anticipated. In the empirical implications section 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.

If one were to take our model to the data and interpret it literally, firm size would be measured by stand-alone values. Stand-alone values could be estimated from market values by subtracting from the market values the value change from takeovers anticipated by the market. The anticipated value change could be estimated by the probability of making an acquisition as well as being acquired for a firm of particular characteristics (for example, its size and the firm size distribution in its industry) multiplied by the average value gain (or loss) in such an acquisition. We do not believe that stand-alone values would be dramatically different from market values or would give rise to very different empirical findings. There appears to be a high degree of new information in most acquisition announcements, as is evident in the high announcement returns for targets and acquirers. An alternative measure of stand-alone size would be book values since they are not affected by anticipated takeover activities. Indeed, some of the literature uses this as proxy for firm size and in general the findings focusing on book values and market values are very similar (see, e.g., Moeller et al. (2004)). In our empirical work below, this is what we use.

## **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 multi-



ple 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 and five firms. There is no reason for the largest firm to make a date 0 acquisition in the four-firm model since even without a date 0 acquisition Firm 1 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 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 be still available. However, we do need a limit on the speed with which firms can make acquisitions. We believe that in reality transactions costs and also competition for targets make current firm size an important determinant of future firm size and hence current firm size matters for the probability of being taken over.

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 model is so simple only because of the simplifying assumptions that make our model tractable. As a consequence, one should not draw any empirical implications from the behavior of the largest firm in our model. Of course, our model also abstracts 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**

As discussed above, the theory developed in this paper can explain several stylized facts about mergers. It is also consistent with existing evidence on defensive acquisitions in the U.S. banking industry presented by Louis (2004). He shows that banks that were takeover targets and then engage in acquisitions are less likely to be acquired than targeted banks that do not make an acquisition subsequently. Moreover, the acquirers in such mergers, which he interprets as defensive, pay higher premia and experience worse and significantly negative abnormal returns than acquirers in nondefensive mergers. In this section, we discuss additional empirical implications of our theory.

Our theory predicts a negative correlation between measures of private benefits and acquirer announcement returns as well as a positive correlation between managerial equity ownership and announcement returns (see Propositions 1, 2, and 4). The only exception is that in heterogeneous

firm size industries all acquisitions are profitable and hence there is no correlation between private benefits (or managerial equity stakes) and acquirer returns (see Proposition 3). Our general prediction is consistent with Lewellen, Loderer, and Rosenfeld (1985), who find that managerial stock ownership is positively correlated with acquirer announcement returns.

The second factor affecting the defensive motive for an acquisition is firm size. The existing empirical literature is based on examining absolute firm size, rather than relative firm size. In our model “size” refers to relative size – size relative to the largest firm in the industry with profitable acquisition opportunities. We still believe that our model can explain existing size findings to some extent, because size in the sense of our model and absolute size are highly correlated. Using the data introduced in the next section, the correlation is 0.45 (0.51 with the log of total assets). We predict a negative correlation between acquirer returns and acquirer size because large firms are more likely to engage in defensive acquisitions than small firms (see the discussion after Proposition 4). This implication is consistent with the findings in Kahl and Rosen (2002), who show that acquirer returns are decreasing in acquirer size and negative for very large acquirers, and Moeller, Schlingemann, and Stulz (2004), who find that very large acquirers have negative announcement returns and small acquirers have positive announcement returns.<sup>33</sup>

We also predict a negative correlation between acquirer returns and target or deal size, because larger acquisitions are more likely to be defensively motivated (see the discussion after Proposition 4). This is consistent with the evidence in Kahl and Valkanov (2004), who find that acquirer returns are decreasing in the size of the merger transaction. As a consequence of the previous observations on acquirer size and target size, we also predict that the sum of acquirer and target size is positively correlated with private benefits and negatively correlated with acquirer returns. Our theory also predicts that for medium-size firms, the ratio of target to acquirer size is negatively correlated with acquirer returns. In contrast, for small acquirers, we conjecture that the ratio of target to acquirer size and the acquirer’s abnormal returns are positively correlated. This does not directly follow from our model, since the smallest firm in our model that can make an acquisition (Firm 4) has only one potential target (Firm 5). However, in a more general model with a sixth firm, acquiring Firm 5 should be more profitable for Firm 4 than acquiring Firm 6, since it makes it a more attractive takeover target (and the premium is proportional to the firm’s

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<sup>33</sup> Moeller et al. (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. Kahl and Rosen (2002) show that acquirer announcement returns tend to be monotone in acquirer size and, in particular, negative for the largest acquirers.

size). This is consistent with the finding in Moeller et al. (2004) that acquirer announcement returns are decreasing in the size of the target to the acquirer for large acquirers, but the opposite is true for small acquirers.

Some of the implications discussed so far are also consistent with other managerial merger theories. For example, a negative correlation between acquirer returns and acquirer size could arise if one assumes that small firms suffer less from agency problems than large firms. Managers in large firms tend to own a smaller percentage of the firm's shares than those of small firms (Moeller et al. (2004)). Moreover, large firms have larger or less cohesive boards, which tend to be less effective (Yermack (1996)).<sup>34</sup> These theories provide plausible explanations for the size effect. We believe that defensive and positioning motives contribute to the size effect. A negative correlation between deal size and acquirer returns is also consistent with a general empire-building hypothesis that suggests that larger acquisitions are more likely to be driven by managerial empire-building. It would not be easy to discriminate between our theory and these alternatives by looking at the acquirer and target size findings alone, because they are shared by our theory as well as the alternatives. It would be difficult to tell apart the importance of relative and absolute size, because they are highly correlated. However, these alternative managerial theories have difficulties explaining some of the other empirical findings mentioned above (for example the concentration of mergers in industries undergoing a regime shift). In the following we spell out some additional implications of our theory that may discriminate more easily between our theory and other managerial theories. Medium-size firms are the most likely to engage in acquisitions – they engage both in defensive as well as positioning acquisitions (see the discussion after Proposition 4). Our model also suggests that industry structure affects merger activity. This is tested in the next section.

## **VI. An Empirical Test**

In our theory, the most important factor driving merger activity is the firm size distribution in an industry. We predict that homogenous firm size industries (or firms of similar size within an industry) are likely to be characterized by defensive merger waves (when private benefits are high) and hence have the worst average abnormal returns for acquirers. Heterogeneous firm size industries should have the best average abnormal returns for acquirers, and merger waves should occur for low private benefits. Our theory suggests that mixed firm size industries should be characterized by intermediate average abnormal returns for acquirers.

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<sup>34</sup> We are grateful to an anonymous referee for suggesting these explanations.

Moreover, we predict that the probability that a firm makes an acquisition should increase with the share of medium-size firms in its industry. We see this by comparing the equilibrium in Section III (Proposition 4) to those in Sections I and II (Propositions 2 and 3, respectively). There are always two acquisitions in mixed firm size industries, whether private benefits are high or low. In the tests below, we look at all industries and hence pool across situations with high and low private benefits. The key difference between the model in Section III and the earlier models is the presence of firms that make both defensive and positioning acquisitions. Which of these two types of acquisitions they make depends on the level of private benefits. These firms, which we call medium size, must be large enough so that an acquisition deters a reasonable fraction of potential suitors, but small enough that the acquisition does not make them too large to be acquired by all their potential suitors. But as Proposition 4 shows, the additional mergers may not come exclusively from medium-size firms.

Note that it is the presence of medium-size firms rather than the coexistence of small and large firms that drives the additional merger activity in mixed firm size industries. If there were only small and large firms, small firms might not engage in positioning acquisitions if private benefits were low, because they could not become larger and hence more attractive targets than the large firms. Medium-size firms, however, can become larger than the large firms through a positioning acquisition and hence will make these acquisitions for low private benefits.

Thus, the hypothesis we test is:

(H1) As the proportion of medium-size firms in an industry increases, firms are more likely to make acquisitions, all else equal.

We start with a sample of firms which are in both the CRSP and Compustat databases in any year during the period 1983 - 2003. Acquisition data consist of completed mergers and acquisitions by U.S. firms announced between 1983 and 2004 as given in the Securities Data Corporation (SDC) database.<sup>35</sup> 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.

In our model, all mergers are within-industry transactions. An industry is, in the sense of our model a collection of firms that are likely to acquire each other. Thus, in the empirical tests, we want industries to be somewhat closed, in the sense that there are not too many cross-industry

mergers. This suggests a relatively small number of industries. But, we also want industry definitions to be narrow enough so that firms view others in the industry to be natural merger partners. Otherwise we would also include many firms in our relative firm size definitions that are extremely unlikely to acquire the firm. This suggests a larger number of industries. We divide firms into 48 industries using the classification given in Fama and French (1997), dropping firms grouped as in the miscellaneous industry.<sup>36</sup> In our sample, 44.8 percent of mergers are cross-industry. Using a broader definition of an industry, such as French's 5-industry classification means few cross-industry mergers (14.5 percent), but leaves very different types of firms in the same industry (for example, mining companies are in the same industry as hotels). Our final sample, after dropping firms in the miscellaneous industry grouping, has 103,168 firm-year observations. Table 1 gives summary statistics for the sample. All Tables are in Appendix A.

The hypothesis we test, (H1), requires a definition of a medium-size firm. In the spirit of our model, a medium-size firm is one large enough so that some acquisitions can serve as deterrents, but also small enough so 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 model, for simplicity we assume that the largest suitor is the same as the largest firm. While this is without loss of generality in the model, 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 few. For these reasons, we chose the medium size range to capture firms that are not the largest in an industry, but still are relatively large compared to the mass of firms. There are enough firms larger than these firms 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.

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 seen in Table 1, only 2.6% of firms are large when we use a 30% size ratio cutoff between medium and large.<sup>37</sup> Since not all of these larger firms have profitable merger opportunities, a medium-size firm may be able to use an acquisition to deter some potential suitors. With a 5%

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<sup>35</sup> We do not include mergers where the target is listed as a government organization or joint venture.

<sup>36</sup> The industry classifications for the 48-industry grouping and the 5-industry grouping we use as a robustness test are available at [mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). We thank Ken French for making these data available. Using 2-digit SIC codes to define industries gives less explanatory power, but similar results.

<sup>37</sup> In roughly 20% of the industry-year observations, there is no other firm that is more than 50% of the size of the largest firm in the industry.

size ratio cutoff between small and medium, we classify roughly 8% of firms as medium-size. This means that medium-size firms are, as we desire, large relative to the mass of smaller firms.

Let  $Future\ merger_{j,i,t}$  be a dummy variable that is one if and only 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 date). The mean value of Future Merger is 0.118 which means that there was at least one acquisition in 12,154 firm-year observations. The total number of mergers in our sample is larger than this, since many firms made more than one acquisition in a calendar year. The sample contains 19,699 mergers with a total deal value of \$5.2 trillion.

To test whether the distribution of firm sizes affects acquisition activity, we use the regression:

$$(5) \text{ Future merger}_{j,i,t} = f(\text{Percent of medium-size firms}_{i,t}, \text{firm-specific controls, year dummies, industry dummies}),$$

where  $\text{Percent of medium-size firms}_{i,t}$  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. In all the regressions we calculate robust standard errors, including controls for firm-level cluster effects. Hypothesis (H1) predicts that the coefficient on  $\text{Percent of medium-size firms}_{i,t}$  is positive.

We use firm-specific controls that other studies suggest may affect merger activity. There is evidence that (absolute) firm size can affect the probability of making an acquisition (e.g., Harford (1999)), so we include the log of total assets as a control ( $\text{Log assets}_{j,t}$ ). We also include a squared log assets term to control for any non-linearity in the relationship between size and merger activity. Firm health is accounted for using the increase in a firm's stock price in year  $t$  ( $\text{Stock market return}_{j,t}$ ) and the firm's market-to-book ratio ( $\text{Market/book}_{j,t}$ ). 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), Golbe and White (1988), and Shleifer and Vishny (2003)). Q-theory suggests that a firm's investment rate (possibly including mergers) should be increasing in the market-to-book ratio (Jovanovic and Rousseau (2002)). Capital structure can also play a role in merger decisions since firms with high leverage have an incentive to underinvest (Myers (1977)). This leads us to follow other studies by including  $\text{Equity/asset}_{j,t}$ , the (accounting) leverage ratio, as a control. Firms with more free cash flow may be more able or more willing to make acquisitions. We control for this using the ratio of EBITDA to sales (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 for whether the firm made an acquisition in year  $t$  ( $Recent\ acquisition_{j,t}$ ) as controls.<sup>38</sup> We include the industry's Herfindahl index ( $Industry\ Herfindahl$ ) because industry concentration could affect merger activity. The year dummies pick up any economy-wide factors that affect the probability of merging and the industry dummies capture industry fixed effects.

The first column of Table 2 presents our baseline regression results. The coefficient on *Percent of medium-size firms* is positive and significant at the 1% level indicating that firms in industries with a larger proportion of medium-size firms are more likely to make acquisitions, consistent with (H1). This new result provides evidence in support of our theoretical model. The effect is fairly large. One can calculate from regression specification (1) that a one standard deviation increase in the percentage of medium-size firms in its industry increases the probability of a firm making an acquisition by 2.2 percentage points. This is an increase of about 18.2% in the mean acquisition probability.

The other coefficients generally are consistent with intuition. Larger firms make more acquisitions (although the squared term enters negatively) as do firms with prior acquisitions, better recent performance, faster recent growth, and lower leverage. The coefficient on the industry Herfindahl index is insignificant. This may be because we include industry dummies and there is little variation in an industry's Herfindahl index over time.

In the model, mergers affect the likelihood that a firm is acquired because they change the firm's size. This suggests that acquisitions of very small targets may have little impact on future acquisition activity. For this reason, as a robustness check, we run our tests using different thresholds for what constitutes a "significant" merger. We let *Ratio* be the ratio of the value offered for the target to the acquirer's market value.<sup>39</sup> We present results where qualifying mergers have a minimum *Ratio* of 5%, 10%, and 25%. As shown in Table 1, increasing the cutoff significantly reduces the number of mergers that we include as qualifying acquisitions. With no cutoff, 11.8% percent of firms made an acquisition in a given year. Adding a 5% cutoff reduces the share of firms with a qualifying acquisition to 7.5%. At a 25% cutoff, only 2.9% of firms make a qualifying acquisition.

The final three columns of Table 2 present regression results for the different minimum ratios of deal value to acquirer size for mergers. The coefficient on *Percent of medium-size firms* is

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<sup>38</sup> With the exception of asset size and the recent acquisition dummy, we winsorize all the firm-specific controls at the 1% level.

<sup>39</sup> 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.

positive and significant at least at the 5% level in all the regressions. This provides additional support for (H1).

We do several tests to illustrate the robustness of our results by examining an alternative industry definition and changes in our size ratio cutoffs. The first column of Table 3 give regression results for the baseline model when firms are grouped into 5 Fama-French industries.<sup>40</sup> The coefficient on *Percent of medium-size firms* is positive and significant, but only at the 10% level. Moreover, the magnitude of the effect is much smaller than in the specification with 48 Fama-French industries, as can be calculated from the regression. This is reassuring, since one would expect the firm size distribution to matter less if industries are very broadly defined and hence firms are not as natural merger partners. We also run our baseline model for different definitions of a medium-size firm. The second column of Table 3 reports results when medium-size firms are those with between 5% and 40% of the assets of the largest firm in the industry and the third column of Table 3 reports results when medium-size firms are those with between 10% and 60% of the assets of the largest firm in the industry. As indicated by the results, we maintain statistical significance (although only at the 10% level for the last definition) on *Percent of medium-size firms* when we change the definition of a medium-size firm. In general, our robustness tests indicate support for (H1).

## VII. Conclusion

In this paper we have argued that in industries with economies of scale, firm size is driving mergers. Firms may engage in a race for firm 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 may allow them to preserve their private benefits of control but are unprofitable. Second, firms may want to engage in profitable acquisitions to become larger and hence position themselves as more attractive takeover targets. We show that industry structure – the size distribution of the firms in the industry – is a very important determinant of which mergers occur. Industries in which many firms are similar in size to the largest firm with profitable acquisition opportunities are prone to defensive merger waves if managers care a lot about the private benefits of control. However, industries in which firms are of very different size are less prone to waves of unprofitable acquisitions. In contrast, they may display merger waves of profitable acquisitions if 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 if private benefits are either low or 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 lose money, 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 both acquirer size (Kahl and Rosen (2002) and Moeller, Schlingemann, and Stulz (2004)) and the size of the merger transaction (Kahl and Valkanov (2004)) as well as the worse acquirer returns in defensive acquisitions (Louis (2004)). We caution, though, that the notion of size in our model is slightly different than, although highly correlated with, absolute size as used in the empirical literature. We test one empirical implication that is central to our theory, namely, that industry firm size distribution matters for merger activity. In particular, we test whether, as predicted by our model, firms in industries with more medium-size firms are more likely to make acquisitions. Our evidence supports this prediction. We leave the testing of our other predictions to future empirical work.

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<sup>40</sup> As noted earlier, this classification scheme comes from French's web site.

## Appendix A: Tables

**Table 1. Summary statistics**

The table contains summary statistics for the 103,168 firm-year observations. For observations in year  $t$ , Future merger takes the value 1 if a firm acquires another firm in year  $t + 1$ , and is otherwise 0. Recent acquisition takes the value 1 if a firm acquires another firm in year  $t$ . For both merger variables, the ratio cutoffs are based on the ratio of the value paid for the target divided by the market value of the acquirer at the end of the year prior to a merger announcement. An  $X\%$  cutoff includes all mergers with a ratio above  $X\%$ . With the exception of the stock market return and asset growth rate, all other variables are as of the end of year  $t$ . The size ratio is the ratio of the total assets of the firm divided by the total assets of the largest firm in its industry. There are 48 industries as defined by Fama and French (1997), but we drop firms in the miscellaneous group. The stock market return is the return for a firm's stock in year  $t$ . Market/book is the ratio of the market value of equity to the book value of equity. Equity/assets is the ratio of book equity to total assets. EBITDA/sales is the ratio of earnings before interest, taxes, depreciation, and amortization divided by total sales. Asset growth rate is the rate of growth of total assets in year  $t$ .

	Mean	Median	Standard deviation
<b>Future merger</b>	0.118	0	0.322
<b>Future merger (5% ratio cutoff)</b>	0.075	0	0.263
<b>Future merger (10% ratio cutoff)</b>	0.056	0	0.229
<b>Future merger (25% ratio cutoff)</b>	0.029	0	0.167
<b>Share of industry that is small (size ratio &lt; 5%)</b>	0.894	0.941	0.113
<b>Share of industry that is medium size (size ratio <math>\in [5\%, 30\%]</math>)</b>	0.080	0.042	0.081
<b>Share of industry that is large (size ratio &gt; 30%)</b>	0.026	0.013	0.035
<b>Total assets (\$ million)</b>	3,495	182	23,835
<b>Stock market return</b>	0.166	0.067	0.654
<b>Market/book</b>	2.533	1.495	3.530
<b>Equity/asset</b>	0.468	0.460	0.245
<b>EBITDA/sales</b>	-0.041	0.113	1.091
<b>Asset growth rate</b>	0.137	0.048	0.422
<b>Industry Herfindahl</b>	0.113	0.077	0.098
<b>Recent acquisition</b>	0.130	0	0.336
<b>Recent acquisition (5% ratio cutoff)</b>	0.090	0	0.286
<b>Recent acquisition (10% ratio cutoff)</b>	0.067	0	0.251
<b>Recent acquisition (25% ratio cutoff)</b>	0.035	0	0.185

**Table 2. Regressions of the probability of being an acquirer on percent of medium-size firms.**

The sample contains 103,168 firm-year observations. The dependent variable is Future merger. For observations in year t, Future merger takes the value 1 if a firm acquires another firm in year t + 1, and is otherwise 0. Recent acquisition takes the value 1 if a firm acquires another firm in year t. For both merger variables, the ratio cutoffs are based on the ratio of the value paid for the target divided by the market value of the acquirer at the end of the year prior to a merger announcement. An X% cutoff includes all mergers with a ratio above X%. With the exception of the stock market return and asset growth rate, all other variables are as of the end of year t. Log assets is the natural log of total assets. The percent of industry that is medium size is the percent of a firm's industry where the size ratio is between 5% and 30%, where the size ratio is the ratio of the total assets of the firm divided by the total assets of the largest firm in its industry. There are 48 industries (Fama and French, 1997), but we drop firms in the miscellaneous group. The stock market return is the return for a firm's stock in year t. Market/book is the ratio of the market value of equity to the book value of equity. Equity/assets is the ratio of book equity to total assets. EBITDA/sales is the ratio of earnings before interest, taxes, depreciation, and amortization divided by total sales. Asset growth rate is the rate of growth of total assets in year t. The industry Herfindahl is the Herfindahl index for the firm's industry.

	(1) <i>All mergers</i>	(2) <i>Ratio &gt; 5%</i>	(3) <i>Ratio &gt; 10%</i>	(4) <i>Ratio &gt; 25%</i>
<b>Pct of industry that is medium size</b>	0.642 (0.008)***	0.863 (0.004)***	0.792 (0.020)**	1.067 (0.022)**
<b>Log assets</b>	0.457 (0.000)***	0.398 (0.000)***	0.311 (0.000)***	0.189 (0.000)***
<b>(Log assets)<sup>2</sup></b>	-0.017 (0.000)***	-0.022 (0.000)***	-0.019 (0.000)***	-0.014 (0.001)***
<b>Stock market return</b>	0.228 (0.000)***	0.219 (0.000)***	0.219 (0.000)***	0.164 (0.000)***
<b>Market/book</b>	0.039 (0.000)***	0.012 (0.005)***	0.001 (0.909)	-0.009 (0.177)
<b>Equity/asset</b>	0.874 (0.000)***	0.364 (0.000)***	0.105 (0.155)	-0.297 (0.002)***
<b>EBITDA/sales</b>	0.082 (0.000)***	0.061 (0.001)***	0.052 (0.010)***	0.032 (0.170)
<b>Asset growth rate</b>	0.190 (0.000)***	0.272 (0.000)***	0.270 (0.000)***	0.314 (0.000)***
<b>Industry Herfindahl</b>	-0.205 (0.323)	-0.115 (0.663)	-0.315 (0.310)	-0.075 (0.852)
<b>Recent acquisitions</b>	1.161 (0.000)***	1.011 (0.000)***	0.927 (0.000)***	0.892 (0.000)***

*Year and industry dummies not shown.*

Recent acquisitions includes only mergers meeting ratio restrictions.

Robust p values in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 3. Robustness regressions of the probability of being an acquirer on percent of medium-size firms.**

The dependent variable is Future merger. For observations in year  $t$ , Future merger takes the value 1 if a firm acquires another firm in year  $t + 1$ , and is otherwise 0. Recent acquisition takes the value 1 if a firm acquires another firm in year  $t$ . For both merger variables, the ratio cutoffs are based on the ratio of the value paid for the target divided by the market value of the acquirer at the end of the year prior to a merger announcement. An  $X\%$  cutoff includes all mergers with a ratio above  $X\%$ . With the exception of the stock market return and asset growth rate, all other variables are as of the end of year  $t$ . Log assets is the natural log of total assets. In the regressions in the first column, the percent of industry that is medium size is the percent of a firm's industry where the size ratio is between 5% and 30%, where the size ratio is the ratio of the total assets of the firm divided by the total assets of the largest firm in its industry. The regression in the second column defines a medium-size firm as one with a size ratio between 5% and 40% while for the regression in the last column, a medium-size firm is one with a size ratio between 10% and 60%. The regression in the first column uses 5 industries as defined by French and the last two columns use 48 industries as defined by Fama and French (1997) (dropping firms in the miscellaneous group). The stock market return is the return for a firm's stock in year  $t$ . Market/book is the ratio of the market value of equity to the book value of equity. Equity/assets is the ratio of book equity to total assets. EBITDA/sales is the ratio of earnings before interest, taxes, depreciation, and amortization divided by total sales. Asset growth rate is the rate of growth of total assets in year  $t$ . The industry Herfindahl is the Herfindahl index for the firm's industry.

	(1) <i>5 industry groups</i>	(2) <i>Medium size: size ratio <math>\in [5\%, 40\%]</math></i>	(3) <i>Medium size: size ratio <math>\in [10\%, 60\%]</math></i>
<b>Pct of industry that is medium size</b>	1.008 (0.085)*	0.569 (0.012)**	0.520 (0.067)*
<b>Log assets</b>	0.424 (0.000)***	0.457 (0.000)***	0.457 (0.000)***
<b>(Log assets)<sup>2</sup></b>	-0.016 (0.000)***	-0.017 (0.000)***	-0.017 (0.000)***
<b>Stock market return</b>	0.228 (0.000)***	0.228 (0.000)***	0.228 (0.000)***
<b>Market/book</b>	0.037 (0.000)***	0.039 (0.000)***	0.039 (0.000)***
<b>Equity/asset</b>	0.698 (0.000)***	0.874 (0.000)***	0.876 (0.000)***
<b>EBITDA/sales</b>	0.109 (0.000)***	0.082 (0.000)***	0.082 (0.000)***
<b>Asset growth rate</b>	0.195 (0.000)***	0.190 (0.000)***	0.190 (0.000)***
<b>Industry Herfindahl</b>	-0.721 (0.103)	-0.205 (0.326)	-0.268 (0.200)
<b>Recent acquisitions</b>	1.212 (0.000)***	1.161 (0.000)***	1.161 (0.000)***
Observations	103,713	103,168	103,168

*Year and industry dummies not shown.*

Robust p values in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

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### Figure 1: Timing in the Three-firm Model

Date 0

Firms learn parameters of the model.

Firm 1 decides whether to make an acquisition offer, and, if so, which Firm to acquire.

Target firm shareholders decide whether to accept the acquisition offer.

Firm 2, if it has not been acquired, decides whether to make an acquisition offer, and, if so, which Firm to acquire.

Target firm shareholders decide whether to accept the acquisition offer.

Date 1

Firms learn state of nature: either good or bad.

In both states, repeat acquisition moves as at date 0.

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