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Do Envious CEOs Cause Merger Waves?

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We develop a theory which shows that merger waves can arise even when the shocks that precipitated the initial mergers in the wave are idiosyncratic. The analysis predicts that the earlier acquisitions produce higher bidder returns, involve smaller targets, and result in higher compensation gains for the acquirer's top management team than the later acquisitions in the wave. We find strong empirical support for these predictions. The model also generates additional predictions, some of which remain to be tested. (*JEL* G34)

> Men are so constituted that every one undertakes what he sees another successful in, whether he has aptitude for it or not.
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> —Johann Wolfgang von Goethe (1749–1832), German Poet, Dramatist, Novelist

Corporate mergers are central to the theory of the firm because they redefine firm boundaries. An enduring stylized fact about mergers is that they often come in waves (e.g., Nelson 1959; Weston, Mitchell, and Mulherin 2003). Why?[1] This is the question we address.

Various explanations have emerged from empirical studies.[2] Banerjee and Eckard (1998) conclude that the merger wave of 1897–1903 resulted from firms merging to improve operational efficiency. Maksimovic and Phillips (2001) document that merger waves are procyclical. Mitchell and Mulherin (1996) provide evidence that fundamental industry-specific economic shocks cause merger waves. Rhodes-Kropf, Robinson, and Viswanathan (2005) provide evidence on how market valuation shifts affect merger waves.

There are also theories of merger waves, dating back at least to Gort (1969), who hypothesizes that economic disturbances produce discrepancies in the valuations of firms that then result in mergers.[3] Lambrecht (2004) proposes

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[1] Brealey and Myers (2003) include this in their list of ten unsolved problems in finance.

[2] An exception to papers that document that mergers come in waves is a paper by Shughart and Tollison (1984), who examine annual data on U.S. mergers during 1895–1979 and conclude they cannot reject the hypothesis that merger levels are characterized by white noise or stable first-order autoregressive process.

[3] Gort (1969) also provides supporting empirical evidence.

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that the timing of mergers is linked to economies of scale during economic expansions. Merger synergies increase with product market demand, and this causes merger waves to be procyclical. Shleifer and Vishny (2003), like Gort (1969), assume that the stock market sometimes misprices some firms, and develop a model in which acquisitions are undertaken to exploit the mispricing. Rhodes-Kropf and Viswanathan (2004) assume that managers observe their own firms' misvaluation but not market-wide misvaluation and show that targets underestimate the overvaluation of bidders and overestimate merger synergies during periods of high market valuation, leading to merger waves.

Despite these insights, there is still much that remains to be understood. First, while merger waves in some industries may be motivated by scale economies, we have also witnessed merger waves in industries with questionable scale economies. For example, the merger wave in the banking industry in the United States in the 1990s, triggered in part by the dismantling of interstate branching restrictions, was ostensibly due to scale economies, but the empirical evidence on scale economies in banking militates against that interpretation (e.g., Berger and Hannan 1989, 1992; Berger and Humphrey 1991; Berger 1995). Second, while market mispricing may engender merger waves, the question of why merger waves are more commonplace in bull markets than in bear markets deserves further attention. After all, there is no *a priori* reason for there to be more mispricing in a bull market than in a bear market.[4] Third, Harford (2005) documents that merger waves are caused by industry shocks combined with the availability of sufficient capital market liquidity, and *not* by attempts to time the market. This evidence leaves open the question of what might cause a merger wave in an industry in which the wave-precipitating shock is not motivated by market mispricing and might affect just one or a few firms, as well as questions related to the kind of theoretical framework needed to understand why market liquidity is higher during bull markets and how this liquidity helps propagate merger waves.[5]

We develop a theory of merger waves that addresses these issues without relying on assumed liquidity differences across bull and bear markets, and also generates additional predictions, some of which we test. We start with a simple premise: CEOs have preferences defined over both absolute and relative consumption, with relative-consumption preferences characterized by *envy*. Whenever we refer to a CEO, we mean the CEO of a *bidding* firm, and by

[4] Moreover, to the extent that overvaluation is more likely in a bull market and undervaluation is more likely in a bear market, why do we not see merger waves during bear markets in which acquirers are bargain-hunting for undervalued firms? (see Brealey and Myers 2003).

[5] Malmendier and Tate (2008) provide recent evidence that CEO overconfidence/overoptimism may lead to a merger. While that is an interesting hypothesis in the context of explaining value-destroying mergers, it does not address merger *waves*, and it is difficult to extrapolate their evidence to draw any conclusions about merger waves in the absence of a theory of correlated overconfidence/overoptimism. Ahern and Weston (2007) review the literature to compare competing explanations for mergers and acquisitions.

envy, we mean that an individual's utility is increasing in the difference between his consumption and that of the person he envies. There is now a large literature on the biological, sociological, and economic foundations for envy-based preferences,[6] and substantial empirical evidence that preferences display envy.[7] Assuming envy-based preferences generates a simple yet powerful intuition for why mergers come in waves. If CEOs envy each other based on relative compensation and CEOs of bigger firms get paid more, then a merger in the industry that increases firm size for one CEO will cause other envious CEOs to be tempted to undertake value-dissipating but size-enhancing acquisitions, thereby starting a merger wave.

There is a similarity between an envy-based motivation to merge and Roll's (1986) hubris hypothesis. Some behavioral manifestations of envy may look like hubris. Roll (1986) discusses how managerial hubris in bidding firms can explain acquisitions despite poor bidder returns.[8] Similarly, envy explains the urge to merge despite poor bidder returns. A difference is that hubris cannot explain merger *waves* unless one assumes cross-sectionally correlated hubris.

At this level, the envy-based intuition is so simple that it requires little additional structure. However, while this intuition explains merger waves, it does *not* provide additional testable predictions,[9] nor does it permit us to juxtapose our theory with other competing explanations that generate some implications that overlap with ours, but differ in other respects.

To refine the intuition and extract additional testable predictions, we develop a formal model. The CEO of a firm within a size and/or industry cohort receives a possibly *idiosyncratic* shock that justifies an acquisition. This increases both the size of the firm and the CEO's compensation, which is increasing in firm size. In the absence of envy, the story would end right here if the shock is purely

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[6] Robson (2001) explains the biological foundations of envy on the basis of evolution, namely that envy is hard-wired into preferences because it facilitates reproductive success. Adams (1963) proposes a theory of inequity in which people compare their own reward (wages)-input (effort) ratios with those of others and adjust their inputs to achieve equality of ratios. The sociological implications of envy are discussed by Elster (1991), who argues that we tend to be more envious of those who we feel are more similar to us. Salovey and Rodin (1984) provide evidence of this. There is a significant literature in economics that has examined the implications of various forms of relative consumption preferences (e.g., Bolton and Ockenfels 2000; Charness and Rabin 2002; Fehr and Schmidt 1999). Other papers have used envy-based preferences to explain a variety of economic phenomena like emulative activity (Clark and Oswald 1998), involuntary unemployment (Akerlof and Yellen 1990), progressive taxation (Banerjee 1990), wage compression (Frank 1984; Lazear 1989; Levine 1991), suboptimal innovation (Mui 1995), and intrafirm allocational distortions, such as corporate socialism in investment (Goel and Thakor 2005).

[7] Experimental evidence on envy is provided by Martin (1981); Clark and Oswald (1996); Zizzo and Oswald (2001); Cason and Mui (2002); and Zizzo (2003). Empirical evidence is provided by Frank (1984); Pfeffer and Davis-Black (1992); Pfeffer and Langton (1993); and Luttmer (2005). Clark, Frijters, and Shields (2008) and Frey and Stutzer (2002) review the literature on happiness and relative positions. Layard (2003) provides a summary of the research on happiness.

[8] In a recent working paper, Aktas, de Bodt, and Roll (2007) report evidence of learning by hubris-infected managers.

[9] And since a direct empirical proxy for CEO envy may be elusive, it is not easy to see how one would take this basic intuition to the data, so extracting predictions that do not depend on the need to develop direct proxies for envy is important. We offer some thoughts on proxies later in the article.

idiosyncratic. Envy, however, induces a correlation in merger activities by making other CEOs in this cohort envious of the larger firm size and compensation now linked with the CEO of the firm that acquired first. Consequently, even if their own synergies do not warrant acquisitions, these CEOs acquire in order to diminish the utility-sapping impact of their envy. Moreover, as more firms merge, the effects of envy get stronger for the CEOs who have not joined the fray. Thus, the model predicts that the envy-induced cross-sectional correlation in mergers is generated by the *sequential* decisions of firms, which then leads to results about how the gains from mergers vary depending on the *timing* of the merger within the wave. In particular, assuming that CEOs care both about firm value and envy-induced comparisons with other CEOs, we get the result that it takes smaller synergies to induce the later acquirers in the merger wave to seek acquisitions.[10] Hence, another prediction is that bidder gains for later acquisitions in a merger wave are smaller than those for earlier acquisitions in the wave. Moreover, the increase in the total compensation of the acquiring firm's CEO and top management team is higher in earlier acquisitions than in later acquisitions, and targets in earlier mergers are smaller than in later mergers. An additional related prediction is that more envious CEOs are more likely to engage in acquisitions and pay higher premiums.

We then ask: Are there systematic triggers for merger waves? We now extend the model to interpret firm size in market value terms, so that CEO envy is defined over market capitalization. Due to the empirical regularity that firms' returns become less highly correlated during stock market upturns and more highly correlated during market downturns, we observe that a large positive shock to market returns will increase the size (market capitalization) disparity among firms in a cohort, and a large negative shock to market returns will have the opposite effect. This increased size disparity makes merger waves caused by envy to become more likely, so a merger wave is more probable in a bull market. And because the bull-market mergers are motivated by envy, they are of lower quality than bear-market mergers. Moreover, the analysis predicts that if we control for the dispersion in market values, the bull-versus-bear-market effect on merger activity largely disappears. We also discuss how our predictions differ from those generated by a model in which a merger wave is caused by an industry-wide shock.

We confront three of our empirical predictions with the data: (1) the earlier targets in a merger wave are smaller than the later targets; (2) bidder returns in a merger wave are lower for later bidders than for earlier bidders; and (3) the gain in compensation for the top management team of the acquiring firm is higher in earlier mergers than in later mergers. All these predictions are novel. Our tests provide strong empirical support for all predictions.

The rest of the article is organized as follows. Section 1 describes the model. Section 2 has an analysis of mergers, both with and without envy. Section 3

[10] This is because the effect of envy gets stronger the longer a merger wave has gone on.

discusses real-world compensation practices, industry effects, and other explanations for merger waves. Section 4 contains the empirical analysis. Section 5 concludes. All proofs are in the Appendix.

1. The Model

This section describes firms, how they merge, the time line, and the preferences.

1.1 Firms in the economy

There are N ex ante identical, all-equity financed firms, indexed 1 to N that are potential acquirers. Each firm has one share outstanding. The preacquisition stock price, as well as the value of each potential acquirer, is P^A. There are also N potential target firms indexed 1 to N.[11] An acquirer firm indexed i may merge only with the target firm i. The idea is that not all firms are adequate targets for an acquirer. We shall call the pair consisting of acquirer firm i and target firm i as "pair i of firms." A merger between acquirer i and target j ($i \neq j$) is assumed to result in value losses large enough to preclude a merger possibility. Thus, we do not consider multiple bidders for a target or multiple targets for an acquirer.

If acquirer i merges with target i, its postacquisition stock price will be P_i^M. If acquirer i does not merge, its stand-alone stock price will be P^O.[12] The "value gain" from the merger to the acquirer's shareholders, $V_i^* = P_i^M - P^O$, represents the realization of a random variable. The (preacquisition) size of target i, measured by its stock price, is P_i^*. Firm sizes, acquirers' standalone stock price P^O, and the probability distribution of V_i^*, f, are common knowledge. However, the value of V_i^* is privately known to the CEO of firm i before its acquisition and is publicly revealed immediately after an acquisition.

1.2 Mergers

Each acquirer has its own Chief Executive Officer (CEO) who decides whether the firm merges with its target. The shareholders cannot directly make an acquisition decision, but they can incent the CEO through an appropriate wage contract to influence his acquisition decision.

Since our focus in on the decisions of acquiring CEOs, we treat the targets as passive players and assume that the value gain from the merger to the acquirer is net of the merger gains accruing to the target as a result of preacquisition bargaining. Acquisition bids don't fail in our model because bids anticipate target-bidder bargaining.

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[11] From now on, we shall omit the term "potential" and just refer to firms as acquirers and targets even though some of these firms may not merge.

[12] It is not essential that P^O and P^A be equal since P^A may impound market expectations about the likelihood of an acquisition.

1.3 Timeline

There are $D + 1$ dates: date 0 to date D. On date 0, there are exogenous shocks to the value gains from acquisitions for all firms. The CEO of firm i privately observes the value gain, V_i^*, for firm i. On each of the dates 1 through D, each firm decides whether to acquire and publicly announces its decision. If firm i acquires, V_i^* is publicly revealed. Wages of acquirer CEOs are paid on date D.

Once a firm prefers an acquisition over no acquisition, it will wish to acquire right away if there is a positive probability that the acquisition opportunity may be ephemeral. So we assume that a firm will make its acquisition on the first date that acquiring becomes the preferred choice. This avoids an uninteresting indeterminacy in the timing of acquisition decisions. We define random variables M_i, $1 \leq i \leq N$, such that $M_i = 1$ once acquirer i merges with target i and $M_i = 0$ otherwise. Further, θ^n is the set of firms that merge on date n, $1 \leq n \leq D$, and $\Theta^n \equiv \bigcup_{t=1}^{n} \theta^n$ is the set of all firms that have merged on or before date n.

1.4 CEO wages and preferences

The wage of the CEO of acquirer firm i, W_i, depends on the firm's stock price and on its acquisition decision. If firm i does not acquire, its CEO gets a fixed wage $W_i = W^O$. If firm i does acquire, its CEO gets a wage $W_i = w(P_i^M)$ contingent on the firm's postacquisition stock price, P_i^M.[13] The stock prices P^O and P_i^M are net of the CEO's wage. We assume that the CEO's postacquisition wage is increasing in the stock price, that is, $w' > 0$, consistent with the common use of stocks and stock options in executive compensation. Moreover, since the CEO is privately informed about merger value, an optimal compensation contract will make his wage an increasing function of the stock price. The expected utility of the CEO of firm i is

$$U_i = u(W_i) - d \times M_i + \delta \sum_{j=1}^{N} \phi(W_i - W_j), \tag{1}$$

where the function u depends only on the CEO's own wage, with $u' > 0$, $u'' < 0$. The constant $d > 0$ represents the CEO's personal cost of the time and effort to implement an acquisition. The function ϕ captures the CEO's envy-related utility that depends on relative wages.[14] A CEO experiences envy-related disutility only when his wage is lower than that of another CEO. That is, $\phi(x) = 0$ for $x \geq 0$. Further, $\phi'(x) > 0$ and $\phi''(x) < 0$ for all $x < 0$. The

[13] The CEO's fixed wage in the absence of a merger is without loss of generality since we do not model any uncertainty or cross-sectional variation in stock prices in the absence of a merger.

[14] A CEO envies those CEOs who are in his cohort or reference group. We are assuming that the CEOs of the N acquirer firms are in the same reference group. We later permit multiple reference groups. The specification of envy is based on Goel and Thakor (2005).

constant $\delta \geq 0$ measures the degree of envy among the CEOs.[15] An increase in a CEO's wage thus has two distinct envy-related effects on *other* CEOs. First, it reduces the utilities of other CEOs. Second, it increases the marginal utility of wage for each of the other CEOs. It is this second effect that drives our analysis. Since the CEO's utility is independent of firm size, the size of the potential target is irrelevant in the main model. A later subsection investigates the effect of target size.

2. Model Analysis: Merger Waves

This section analyzes merger waves. Subsection 2.1 shows that merger decisions are independent in the absence of envy. Subsection 2.2 examines the impact of envy. Subsection 2.3 examines merger waves. Subsection 2.4 shows how stock market conditions may trigger merger waves. Finally, subsection 2.5 allows heterogeneity in target size, and asks how acquisition timing is related to target size.

2.1 Merger decisions without envy

Lemma 1. *If the CEOs do not envy each other and the shocks to value gains from acquisitions are independent across firms, then the acquisition decisions for different firms are stochastically independent of each other; M_i and M_j are uncorrelated for $i \neq j$, $1 \leq i, j \leq N$.*

This result is not surprising since each CEO's acquisition decision is based on an idiosyncratic shock about the acquisition gains. It is easy to show that merger decisions are positively correlated across firms when the value gains from acquisitions are correlated in the cross-section. Merger waves can thus arise even though there is no *causal* relationship between the mergers of different firms. However, while this may explain the time clustering of merger events across firms, the absence of a causal relationship among acquisition decisions means that nothing can be said about the *timing* of mergers by different firms within a wave. That is, there is no prediction of systematic patterns in terms of the attributes of early and late mergers. We shall later contrast this with the situation in which merger waves arise because of envy.

2.2 Sequential decisions with envy

Each CEO knows his firm's acquisition synergy and his postacquisition wage based on this synergy. On each date n, $1 \leq n \leq D$, he updates beliefs μ about the postacquisition wages of CEOs who have not acquired based on the merger history $(\theta^1, \ldots, \theta^{n-1})$ and the postacquisition wages

[15] We are ignoring target CEOs in envy considerations. This does not mean they may not envy or may not be envied. However, for tractability, we do not explicitly consider their envy and assume that their payoffs in the event of a merger compensate them for envy. The merger value to an acquirer is net of value gains to the target, part of which may be used to compensate the target CEO.

of CEOs who have already acquired and uses these beliefs to calculate his expected utility, $U_i(W_i; \theta^1, \ldots, \theta^{n-1} | \theta^n, \ldots, \theta^D)$, conditional on future mergers, $(\theta^n, \ldots, \theta^D)$. CEO i's acquisition decision on date n maximizes $U_i(W_i; \theta^1, \ldots, \theta^{n-1} | \theta^n, \ldots, \theta^D)$.

Proposition 1. *There is a sequential equilibrium such that*

1. *A firm i that has not acquired a target before date n acquires on date n if and only if the CEO's postacquisition wage $w(P_i^M)$ exceeds or equals the threshold wage $\underline{W}^n(\theta^1, \ldots, \theta^{n-1})$.*
2. *The CEO of firm i observes the postacquisition wage of the CEO of firm j if firm j has already acquired and otherwise derives beliefs about this wage from Bayes' rule based on the prior distribution f of the value gain from the acquisition, V_j^*, and the following inference:*

$$w(P^O + V_j^*) < \underline{W}^{n-1}(\theta^1, \ldots, \theta^{n-2}). \tag{2}$$

3. *The threshold wages are decreasing in the envy parameter δ.*
4. *Each threshold wage solution for date D is associated with a unique equilibrium.*

The proposition asserts that it is a sequential equilibrium for a firm to acquire on a particular date only if the CEO's postacquisition wage exceeds a threshold wage that is a function of the history of past mergers.[16] This threshold wage is based on the tradeoff between the cost and benefit of an acquisition to a CEO. The cost is the CEO's disutility of implementing an acquisition, as well as the CEO's envy-related utility loss from the acquisitions of other firms precipitated by the CEO's own acquisition. The benefit stems from the increase in his wage from an acquisition. When the CEO observes acquisitions by other firms, he observes the wage increases of the acquiring CEOs, which induces an envy-related reduction in his utility and an envy-related increase in the marginal utility of the wage increase associated with his own acquisition. Consequently, the threshold wage for an acquisition declines as more firms acquire. This means that the acquisition decisions of the CEOs are spread out over time even though they receive all the information about their acquisition gains at date 0.

2.3 Envy and merger waves

We now show that sequential acquisition decisions of envious CEOs lead to merger waves.

[16] The result that acquisitions are accompanied by wage increases is consistent with the empirical evidence documenting the positive dependence of wages on firm size (Roberts 1956; McGuire, Chiu, and Elbing 1962; Cosh 1975; Ciscell and Carroll 1980; Agarwal 1981; Murphy 1985; Winn and Shoenhair 1988; Kostiuk 1989; Barro and Barro 1990). It is also consistent with the evidence in Bliss and Rosen (2001) that bank acquisitions seem motivated by wage gains for CEOs.

Proposition 2. *There is a positive correlation between merger events of different firms when CEOs envy each other.*

Envy generates a positive cross-sectional correlation in mergers because a firm is more likely to acquire when another firm in its cohort has acquired. The intuition is that the CEO of an acquiring firm experiences an increase in firm size and in his wage. This causes the CEO of a nonacquiring firm to become envious and this envy manifests itself in the CEO experiencing an elevated marginal utility of a wage increase. Consequently, this CEO may achieve a wage increase by acquiring a firm that he otherwise would not have because the marginal utility associated with the accompanying wage increase would have been considered too low compared to the effort involved in the acquisition. Hence, acquisitions are undertaken that would have been eschewed in the absence of previous acquisitions. This is the mechanism by which envy engenders a positive cross-sectional correlation in merger events, even when shocks to value gains from acquisitions are pairwise uncorrelated. While the positive cross-sectional correlation is an essential property of merger waves, not all firms that are part of the wave engage simultaneously in mergers. An interesting question then is which firms merge earlier and which later. Our next result deals with this.

Proposition 3. *The merger-induced increase in the wage of an acquiring firm's CEO is higher in an earlier merger than in a later merger. The value gain to an acquirer is higher in an earlier merger than in a later merger, controlling for target size.*

This proposition says that mergers in a wave occur in decreasing order of the wage increases to the acquirer CEOs.[17] The intuition is that a firm that acquires a target early in a wave is motivated to do so primarily because the value gain from the acquisition results in a sufficiently large increase in the CEO's compensation to make it worthwhile for the CEO to acquire without envy playing a role. Firms with lower value gains opt not to acquire early. However, once other firms have acquired, even the CEOs of firms that abstained earlier may acquire because their envy of other acquiring CEOs leads to an increase in the marginal utility they experience from the merger-related elevation in their wages. Since the postacquisition wages of CEOs are increasing in the value gains from mergers, the empirical implication that follows is that later mergers in a wave will have lower bidder (announcement) returns than earlier mergers.

It is interesting to contrast this result with the discussion in subsection 2.1 about the possibility of a merger wave in the absence of envy if the firms in an industry experience correlated shocks. A key distinguishing feature of the

[17] When we take this prediction to the data, we will examine the increase in the total compensation of the top management team rather than just the CEO, since these decisions typically involve the entire top management team, which experiences an increase in total compensation from the synergy gains due to the acquisition.

envy-based explanation is that it predicts a declining sequence of acquirer value gains among mergers *within* a wave. That is, it provides a novel prediction for the *timing* of mergers within a wave that is not provided by the explanation based on correlated shocks.

Proposition 1 also shows that the threshold postacquisition CEO wage $\underline{W}^n$ is decreasing in envy. This means that nonenvious CEOs are less likely to engage in acquisitions than envious CEOs.[18] Moreover, more envious CEOs should pay higher control premiums than less envious CEOs. To test these two predictions, we would want to develop proxies for envy. One proxy may be the ratio of the CEO's compensation to the average compensation of the CEOs of other firms with comparable size (as measured by market value).

2.4 The triggering effect of bull markets on merger waves

What triggers a merger wave? Thus far, we have shown that envy can cause even an idiosyncratic shock to value gain from acquisition experienced by a single acquirer to open the floodgates and initiate a merger wave. We now show that there may be *systematic* triggers as well. To this end, we extend the model to show that an increase in the cross-sectional dispersion of firm values in a particular cohort can trigger a merger wave. Our basic premise is that periods of economic expansion or high market returns lead to an increase in the cross-sectional dispersion in market values (stock prices) of previously similar firms. The fact that the correlations among the returns of firms decline during periods of high market valuations and increase during market downturns is well documented (see, for example, Kroner and Ng 1998; Bekaert and Wu 2000; Longin and Solnik 2001; Ang and Chen 2002; Duffee 2002). Thus, firms that start out with similar market values are likely to experience divergences in these values that are driven by differences in their returns during periods of escalating market returns. These differences in market values will also lead to large cross-sectional differences in CEO wages. We will show now that this elevates the likelihood of a merger wave, suggesting that merger waves are more likely during periods of high market returns.

We extend the original model by considering two additional firms indexed $N+1$ and $N+2$. Firms $N+1$ and $N+2$ start with the same market value as the rest of the N potential acquirers. However, these firms may experience shocks to their market values, which causes their CEOs' wages to change even in absence of mergers. For simplicity, we assume that these firms are not candidates for mergers, and that this is common knowledge.[19]

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[18] We model CEOs who are equally envious of each other. However, Proposition 1 shows that for a given merger history, the higher the envy, δ, of the CEOs of unmerged firms, the more likely they are to merge.

[19] We could have allowed these firms to be potential acquirers or allowed potential acquirers to experience shocks to their own stock prices, but this assumption simplifies the analysis by allowing us to treat potential acquirers symmetrically, since none of them faces a shock to its market value.

The expected utility of the CEO of acquirer i is given by

$$U_i = u(W_i) - d \times M_i + \delta \sum_{j=1}^{N+2} \phi(W_i - W_j). \tag{3}$$

On date 0, for each of the firms 1 to N, the CEO observes the value gain from a potential acquisition. The firms $N+1$ and $N+2$ experience shocks to their market values. As a result, the wage of the CEO of firm $N+1$ changes to $\overline{W}$ while the wage of the CEO of firm $N+2$ changes to $\underline{W}$. That is,

$$W_{N+1} = \overline{W} \text{ and } W_{N+2} = \underline{W}. \tag{4}$$

We now show that all of our earlier results continue to hold with this extension.

Lemma 2. *Proposition* 1 *holds under the extended model.*

We now turn to the issue of how cross-sectional differences in firm market value (measured by stock price) affect the likelihood of merger waves. For this, consider two scenarios. In the first scenario, there are no shocks to the market values, so every CEO's wage will be W^O in the absence of an acquisition. In the second scenario, firms $N+1$ and $N+2$ experience shocks to their market values and hence to CEO wages. To show that our results do not depend on these shocks to market values being positive or negative, we assume that the wage of the CEO of firm $N+1$ will be $\overline{W} > W^O$, while the wage of the CEO of firm $N+2$ will be $\underline{W} < W^O$. This is a simple way of capturing cross-sectional differences in CEO wages, and we believe that the results will continue to hold with alternative specifications of cross-sectional differences. We now have the following result:

Proposition 4. *For a given realization of value gains from acquisitions,* V_i^*, $i \in [1, \ldots, N]$, and *target sizes, suppose the set of firms that acquire on or before date n is* Θ^n *when firms have the same market values and* $\hat{\Theta}^n$ *when there are cross-sectional differences in market values.* Then $\Theta^n \subseteq \hat{\Theta}^n$ for $1 \leq n \leq N$.

Cross-sectional differences in market value affect the envy-related utility of the CEO of a firm that must decide whether to acquire. Holding the market value of firm i fixed, if a firm with lower market valuation experiences a further reduction in its market value, the utility of the CEO of firm i does not decline due to envy and hence firm i's acquisition decision is unaffected by the negative size shock experienced by the other firm. An increase in the market value of a firm with higher market value, however, causes an envy-related reduction in the utility of the CEO. This reduction in utility can be completely or partially mitigated by the CEO through an acquisition that increases the firm's size and

market value, as well as the CEO's wage. Thus, a CEO's incentive to acquire is strengthened by cross-sectional differences in market values.

The predominance of merger activity during periods of high systematic returns can thus be explained through envy, given the empirically documented lower correlations among the returns of firms during periods of higher market returns.[20] Thus, firms that start with similar sizes as measured by market values (and hence form reference groups for CEO envy) are likely to have lower cross-sectional differences after a period of low market returns than after a period of high market returns. Proposition 4 shows that merger waves are therefore more likely during periods of high market returns than during periods of low market returns, so envy offers a clear explanation for the puzzling stylized fact that merger waves are a bull-market phenomenon and *not* a bear-market phenomenon. Moreover, because this effect is due to envy, mergers that do occur in bear markets are predicted to have greater synergies than those that occur in bull markets. This prediction seems to be consistent with the empirical finding in Bouwman, Fuller, and Nain (2009) that bear-market acquisitions exhibit significantly better long-term operating performance than bull-market acquisitions.

Proposition 1 shows that later mergers in a merger wave are more likely when envy is higher, while Proposition 4 shows that longer merger waves occur in bull markets. Combining these two results yields the prediction that the proportion of acquisitions undertaken by nonenvious CEOs will be lower during merger booms (waves) than during other periods.

Interestingly, because Proposition 4 has to do with the dispersion in firm values rather than bull markets per se, an additional (and more direct) prediction is that, after controlling for dispersion in market valuations, the bull-versus-bear-market effect largely disappears.

On the issue of asymmetric correlations in stock returns across up and down markets, it is also interesting to reflect on the potential underlying reasons for the empirically documented asymmetries and how these might interact with envy. Duffee (2002) hypothesizes and empirically verifies that stock return correlations in up markets are lower because the idiosyncratic volatility of individual stock returns is higher. His "balance-sheet" approach suggests that idiosyncratic return volatility increases as "growth options" or other similar risky assets increase in proportion to less risky and more tangible assets in place. To think about this in our setting, suppose there is an exogenous shock that causes the market to go up, causing an increase in the dispersion in firm values as individual stock returns become less pairwise correlated. Envy may then induce CEOs to undertake acquisitions, some of which may be for cash. This will result in acquiring firms replacing cash assets on their balance sheets with more risky, growth-oriented assets, namely the target companies they acquire. This will drive up the idiosyncratic volatilities in the acquirers' stock returns,

[20] Of course, we cannot rule out alternative explanations for the predominance of mergers during bull stock market runs.

controlling for size and other factors. Envy will, therefore, tend to *reinforce* the initial shock that precipitated a decline in stock return correlations.

2.5 Cross-sectional variation in target size

We now consider how the size (as measured by market value) of the target firm affects the decision of the acquiring firm's CEO. This is important from the perspective of empirical testing because target size is observable, unlike an acquirer firm's expected value gain (V_i^*) from an acquisition. We assume that larger targets are more difficult to integrate with acquirers. The most direct way to model this is to assume that the acquiring CEO has to work harder to achieve postacquisition integration, so $d(P_i^*)$, the disutility experienced by the CEO in implementing the acquisition, is higher for larger targets, where we measure size in terms of market value (P_i^*). That is, we assume that the *ex post* value gain to the acquirer has the same expected value regardless of target size, but the CEO's effort in postacquisition integration is increasing in target size. Since in our analysis all acquirers are initially the same size, it does not matter if we are talking about the absolute size of the acquirer or its relative size. In our subsequent empirical test of the prediction emerging from this analysis, however, we will consider both the absolute size of the target, P_i^*, as well as its size relative to the preacquisition size of the acquirer, P_i^*/P^A.

We now have the following result.

Proposition 5. *The target size is smaller in an earlier acquisition than in a later acquisition, controlling for the value gain to an acquirer.*

The intuition is that since the wage of a CEO making an acquisition is an increasing function of the value gain from the acquisition, the utility gain to the CEO from an acquisition is increasing in the acquirer's value gain from the acquisition but decreasing in the size of the target because of the additional disutility of postacquisition integration imposed by larger targets. Thus, an acquiring firm's CEO prefers a smaller target and a target with greater value gain to the acquirer. Targets with high value gains and small size are therefore acquired earlier in a merger wave. Larger targets that are not initially acquired because of the greater personal cost to the CEO of implementing the acquisition may be acquired later in the merger wave when a CEO's envy of the CEOs who acquired targets previously increases the marginal utility of his expected wage gain from an acquisition sufficiently to overcome the higher utility loss associated with integrating a larger target.

3. Real-world Compensation Practices, Industry Effects, and Comparison with Other Explanations for Merger Waves

This section discusses the impact of real-world executive compensation practices on our analysis and also how our explanation of merger waves compares with other explanations.

3.1 Real-world executive compensation practices

Executive compensation in the real world is set on the basis of benchmarking. In fact, one of the obligations of the Compensation Committee of the Board of Directors is to determine whether the CEO's compensation is consistent with the compensation packages of other CEOs in the industry who run firms of similar sizes. This creates a natural reference group for the CEO to compare his compensation with. When a CEO previously in the benchmarking group moves out of it due to his firm's size as well as his compensation getting larger due to an acquisition, the lower-paid CEOs may feel envious. In other words, real-world executive compensation practices *exacerbate* the envy-based motivation to grow firm size through acquisitions by shining the spotlight on the compensation packages of CEOs at other firms and explicitly linking CEO compensation to firm size.

A related issue is transparency. If corporate governance regulation mandates greater disclosure and transparency in executive compensation, then our analysis implies that envy will exert a greater force in CEO actions. This means that the likelihood of envy-induced merger waves is elevated by greater transparency in executive compensation.

Finally, in our analysis, all CEOs start out with the same compensation. But if the CEOs of the firms that acquire early have lower compensation than other CEOs, then those who do not acquire will have less of an envy-related motivation to initiate mergers. Thus, merger waves are less likely when the CEOs of initial acquirers have relatively low compensation.

3.2 Industry effects

The effect of envy on acquisition strategies is likely to differ across industries. For example, we should expect it to be particularly strong in high-growth, high-risk industries where there is a relatively high probability that firms that start out being of comparable sizes and market values will, at some future point in time, find themselves quite different from each other in size and value because they are subjected to different sales growth and stock return shocks. This will increase the force of envy and may trigger a merger wave. Moreover, industries where product-market competition and scale economies trigger acquisitions of relatively large players by other firms are more likely to experience envy-induced merger waves. By contrast, envy is likely to play a smaller role in industries with a small number of major players of comparable size who cannot acquire each other because of anti-trust impediments, and where most acquisitions are of the "roll-up" variety, involving very small, often-private targets whose acquisitions do not significantly affect the sizes and values of their acquirers.

3.3 Comparison with other explanations of merger waves

In this subsection, we attempt to distinguish the predictions of our model from some other explanations suggested in the literature. A leading explanation for

merger waves is that industry-specific economic shocks cause correlation in mergers across firms in an industry (Mitchell and Mulherin 1996). While our analysis also produces this implication, we also predict that earlier acquisitions in a merger wave will be more valuable than later acquisitions and that the targets in earlier acquisitions will be smaller than those in later acquisitions. Neither prediction is generated by an explanation based on correlated shocks to merger values. The rationale based on correlated economic shocks would suggest a random distribution of value gains from acquisitions across a merger wave, as there is nothing in that theory that predicts acquisition timing within a merger wave.

Another set of explanations is based on market misvaluation. These explanations argue that mergers are correlated because market misvaluation is correlated across firms and overvalued firms are likely to acquire undervalued firms or targets that underestimate the overvaluation of bidders and overestimate bidder synergies (Shleifer and Vishny 2003; Rhodes-Kropf and Viswanathan 2004). These explanations are also based on correlated values from mergers or correlated *perceptions* of value gains rather than cross-sectional causality *between* mergers. Hence, in contrast to our theory, they do *not* offer any prediction about the timing of mergers in a merger wave in terms of target size or bidder returns. Moreover, none of the existing theories provide any predictions about the propensity to acquire based on the degree of envy, something that our analysis generates.

4. Empirical Analysis

We now test three key predictions of our model: (1) acquisitions that are announced earlier during merger waves involve *smaller* targets than those announced during the later parts of merger waves (Proposition 5); (2) the announcement abnormal returns of bidders who announce acquisitions earlier in a merger wave are *higher* than those of bidders who announce acquisitions later (Proposition 3); and (3) the increase in management compensation is *larger* for acquisitions that are announced earlier in a merger wave than for those that are announced later on, controlling for target size (Proposition 3).

We first describe our sample, explain our merger wave classification, and define early versus late acquisitions. Then we explain our empirical approach and provide our results.

4.1 Sample description

We collect data on merger and acquisition deals from the Securities Data Corporation's (SDC) U.S. Mergers and Acquisitions Database. We start with all mergers and acquisitions that were announced between 1 January 1979, and 31 December 2006, and were subsequently completed. We include deals in our sample if they meet the following conditions:

1. The acquirer is a U.S. listed firm and obtains at least 50% of the target's shares.
2. The target is not a subsidiary.
3. The deal value exceeds $2 million.
4. The deal was announced during a merger wave (defined in the next subsection).

4.2 Merger wave classification and early versus late acquisitions

To identify merger waves, we use two alternative classification methods, following the approach in Bouwman, Fuller, and Nain (2009). We classify a month as a "merger-wave month" based on (1) the P/E ratio of the S&P 500; and (2) the M/B ratio of the overall stock market (defined as the median M/B ratio of all publicly listed firms). The first classification method consists of the following steps. We first detrend the market P/E because the S&P 500 has trended upward over time, so using actual values without detrending would cause us to erroneously classify the last few years of the sample period as a merger wave. We achieve the detrending by removing the best straight-line fit from the market P/E of a particular month and the five prior years. We then classify a month as a merger-wave month if that month's detrended market P/E was above this past five-year average.[21] We use a similar approach for our M/B classification method.

We split our sample into acquisitions announced during the earlier stages of a merger wave ("early acquisitions") and those announced during the later stages of a merger wave ("late acquisitions"). We alternatively define early acquisitions as the first 10%, 20%, 30%, 40%, or 50% of all deals announced during merger-wave months. We classify all other acquisitions (i.e., the last 90%, 80%, 70%, 60%, or 50% of all deals announced during such months, respectively) as late acquisitions.

Panels A and B in Table 1 show summary statistics on the number of early and late acquisitions announced during merger waves using our five alternative definitions of early acquisitions (the first 10%, 20%, 30%, 40%, or 50% of all deals announced during merger-wave months), based on our two merger-wave classification methods. Using the P/E of the S&P 500 and the M/B of the stock market, the total number of acquisitions announced during merger waves equaled 5417 and 4134, respectively.

4.3 Empirical approach and results

We first test whether early acquisitions are smaller than late acquisitions. We use a differences-in-means test for this purpose. We focus on both the relative size and the actual size of early and late acquisitions announced during merger waves. We define relative size as the transaction value divided by the market value of equity of the acquirer at the end of the month prior to the acquisition

[21] Bouwman, Fuller, and Nain (2009) call these "high-valuation markets."

Table 1
Summary statistics on early versus late acquisitions in merger waves

Percentage of deals classified as early acquisitions	10%	20%	30%	40%	50%
Panel A: Number of acquisitions—merger wave classification based on P/E of S&P 500					
Number of deals					
Early acquisitions	558	1106	1626	2135	2689
Late acquisitions	4859	4311	3791	3282	2728
All acquisitions	5417	5417	5417	5417	5417
Panel B: Number of acquisitions—merger wave classification based on M/B of stock market					
Number of deals					
Early acquisitions	412	827	1239	1655	2075
Late acquisitions	3722	3307	2895	2479	2059
All acquisitions	4134	4134	4134	4134	4134

Panels A and B show the number of early and late acquisitions announced during merger waves using two alternative merger wave classification methods. The sample period is from 1 January 1979 to 31 December 2006. We use two merger wave classification methods:

P/E of S&P 500: each month from January 1979 to December 2006 is classified as a merger-wave month if the detrended market P/E of that month lies above the past five-year average.

M/B of stock market: uses the M/B ratio of the stock market—the median M/B ratio of all publicly listed firms—rather than the P/E of the S&P 500.

Early acquisitions are the first 10%, 20%, 30%, 40%, or 50% of deals announced in each merger wave. The remaining deals are classified as late acquisitions.

announcement. However, if the deal was announced in the first two weeks of a month, we instead use the market value of equity at the end of the month prior to that. We define the actual size as the transaction value measured in $ millions.

Panel A of Table 2 shows the relative size and actual size results based on our first method to classify merger waves—the P/E of the S&P 500. The numbers in parentheses in this table are *t*-statistics. The results clearly support our prediction that early acquisitions are significantly smaller than late acquisitions. For example, if we define early acquisitions as the first 10% of all acquisitions announced during merger waves and the remaining ones as late acquisitions, the actual size of late acquisitions is $161.1 million larger than the actual size of early acquisitions, and the relative size of late deals is 13.2% larger than that of early acquisitions. If instead we define early acquisitions as the first 20% to 50%, the results remain significant based on actual size, and they remain significant for the first 20% based on relative size. Panel B of Table 2 shows the results based on our second method to classify merger waves—the M/B of the stock market. The results again support our prediction. The actual size of late acquisitions is significantly larger than that of early acquisitions if we define early acquisitions as the first 10%–30% of all merger wave acquirers. The relative size of late acquisitions is significantly larger if we define early acquisitions as the first 10% or 20% of all acquisitions announced during merger waves. Thus, we conclude that early acquisitions are significantly smaller than late acquisitions.

We now turn to our second prediction: announcement abnormal returns of bidders who acquire earlier during a merger wave are significantly higher than

Table 2
Early acquisitions are smaller than late acquisitions in merger waves

Percentage of deals classified as early acquisitions	10%	20%	30%	40%	50%
Panel A: Difference in mean size of late and early acquisitions—merger wave classification based on P/E of S&P 500					
Size definition					
Actual size	161.1	136.8	116.0	82.8	61.9
	(6.58)***	(5.21)***	(4.27)***	(2.87)***	(1.99)*
Relative size	13.2%	9.5%	5.5%	1.9%	−1.0%
	(2.16)**	(2.10)**	(1.43)	(0.56)	(−0.30)
Panel B: Difference in mean size of late and early acquisitions—merger wave classification based on M/B of stock market					
Size definition					
Actual size	115.5	95.0	67.0	51.0	20.1
	(3.29)***	(3.03)***	(2.10)**	(1.59)	(0.60)
Relative size	18.2%	15.5%	12.1%	9.7%	−2.0%
	(2.46)**	(1.97)**	(1.44)	(1.08)	(−0.21)

Panels A and B show results using two merger wave classification methods:

P/E of S&P 500: each month from January 1979 to December 2006 is classified as a merger-wave month if the detrended market P/E of that month lies above the past five-year average.

M/B of stock market: uses the M/B ratio of the stock market—the median M/B ratio of all publicly listed firms—rather than the P/E of the S&P 500.

In each panel, the first result shows the difference in mean actual size of late and early acquisitions. The actual size is the transaction value measured in $ million. The second result shows the difference in mean relative size of late versus early acquisitions, that is, the size of a late acquisition minus that of an early acquisition. Relative size is defined as the transaction value divided by the market value of equity of the acquirer at the end of the month prior to the acquisition announcement. If the deal was announced in the first two weeks of a month, we use the market value of equity at the end of the month prior to that. Early acquisitions are the first 10%, 20%, 30%, 40%, or 50% of deals announced in each merger wave. The remaining deals are classified as late acquisitions. Numbers in parentheses are *t*-statistics. ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

those of bidders who acquire later. Since we have verified empirically that acquisitions announced earlier during a merger wave involve targets that are significantly smaller, we have to use multivariate regressions to control for differences in target size and other factors that may affect announcement abnormal returns. We calculate abnormal returns by deducting the value-weighted market return from the acquirer's return for a three-day window around the acquisition announcement date, from the day before the announcement until the day after. We obtain three-day cumulative abnormal returns (CARs) by summing the abnormal returns over the event window. We regress three-day CARs on *Early Acquisition*, a dummy that equals 1 if the acquisition was announced early on during the merger wave (where "early" is as defined previously); *Relative Size*, the transaction value divided by the market value of equity of the acquirer at the end of the month prior to the acquisition announcement; *Cash*, a dummy variable that equals 1 if the acquisition was paid for in cash; *Mixed Payment*, a dummy variable that equals 1 if the acquisition was paid for using a mixture of cash and stock; *Tender*, a dummy variable that equals 1 if the acquisition was a tender offer. We include year fixed effects and industry fixed effects (based on one-digit SIC Codes) in all regressions.[22]

[22] Results are similar if we use 17 Fama-French groupings instead.

Table 3 show the regression results based on our two merger-wave classification methods. The numbers in the parentheses in this table are *t*-statistics. The results clearly support our prediction. When we classify merger waves based on the P/E of the S&P 500 (panel A), the coefficient on the *Early Acquisition* dummy is positive and significant when we define early acquisitions as the first 20%, 30%, or 40% of all merger-wave acquisitions (*t*-statistics of 2.31, 3.47, and 1.93, respectively). Results based on the M/B of the stock market are even stronger (panel B). The coefficient on the *Early Acquisition* dummy is positive and significant when we define early deals as the first 10%, 20%, 30%, or 50% of all merger-wave deals (*t*-statistics of 2.86, 2.72, 2.54, and 3.98, respectively). Thus, we conclude that the announcement CARs of early deals are significantly higher than those of late deals.

Finally, we turn to the third prediction: the increase in top management compensation is bigger for deals announced earlier in a wave than for those announced later on, controlling for target size. It is important to control for target size in testing this prediction because the evidence on our first prediction indicates that target size varies systematically with the *timing* of the acquisition within a merger wave, and we know from earlier research that executive compensation is correlated with firm size. Our test involves multivariate regressions in which we regress the increase in compensation (to be defined next) on *Early Acquisition* and *Relative Size* (as defined above), and year and industry fixed effects (based on one-digit SIC Codes).[23] The prediction suggests that the coefficient on *Early Acquisition* will be positive and significant.

For all acquirers covered in Compustat's ExecuComp database, we retrieve "total compensation" (item *TDC1*) for each executive from 1992 to 2006.[24] Total compensation includes salary, bonus, other annual pay, the total value of restricted stock granted that year, the Black-Scholes value of stock options granted that year, long-term incentive payouts, and all other total compensation. We calculate the *mean* total compensation of the acquirer's top management team in the year before the acquisition announcement and two years after the announcement, and focus on the percentage increase in mean total compensation over this time period. We choose the top management team rather than just the CEO since the effects of anticipated and realized synergy gains are likely to be reflected in changes in the total compensation levels of the entire top management team, a group typically involved in the acquisition decision.[25]

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[23] We obtain similar results based on the use of 17 Fama-French groupings.

[24] ExecuComp data only starts in 1992 so we lose the first half of our original sample period for the increase in compensation tests.

[25] One could argue that we should also include the top management of the target in this test. However, our theory treats targets as essentially passive players in the game. So, although our model assumes that synergy gains from the merger are shared by the acquirer and the target, Proposition 3 is really about acquisition decisions that are motivated by anticipated merger-induced compensation gains for the acquiring firm's management. Moreover, ExecuComp covers only a small fraction of the targets, so we would lose much of our sample by including target management compensation. In any case, since our theory relies on at least some portion of the merger synergy gains accruing to the acquiring firm and management compensation increasing as a consequence of that, focusing on the compensation of the top management of the acquirer is sufficient for our tests.

Table 3
Early acquisitions have higher CARs than late acquisitions in merger waves

Percentage of deals classified as early acquisitions	Dependent variable: *CAR*				
	10%	20%	30%	40%	50%
Panel A: CAR regressions—merger wave classification based on P/E of S&P 500					
Early Acquisition	0.007	0.009	0.012	0.007	0.004
	(1.37)	(2.31)**	(3.47)***	(1.93)*	(1.14)
Relative Size	0.000	0.000	0.000	0.000	0.000
	(0.10)	(0.12)	(0.15)	(0.10)	(0.07)
Cash	0.008	0.008	0.008	0.008	0.008
	(2.72)***	(2.70)***	(2.73)***	(2.73)***	(2.73)***
Mixed Payment	0.013	0.013	0.013	0.013	0.013
	(3.41)***	(3.37)***	(3.40)***	(3.39)***	(3.40)***
Tender	0.014	0.014	0.014	0.014	0.014
	(3.36)***	(3.39)***	(3.39)***	(3.40)***	(3.39)***
Constant	0.000	−0.001	−0.002	−0.002	−0.001
	(0.01)	(0.05)	(0.17)	(0.14)	(0.06)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Observations	5417	5417	5417	5417	5417
Adjusted R^2	0.01	0.01	0.01	0.01	0.01
Panel B: CAR regressions—merger wave classification based on M/B of stock market					
Early Acquisition	0.014	0.011	0.009	0.005	0.012
	(2.86)***	(2.72)***	(2.54)**	(1.50)	(3.98)***
Relative Size	0.000	0.000	0.000	0.000	0.000
	(1.18)	(1.19)	(1.19)	(1.18)	(1.11)
Cash	0.010	0.010	0.010	0.010	0.010
	(2.97)***	(3.00)***	(3.04)***	(3.02)***	(3.02)***
Mixed Payment	0.013	0.013	0.013	0.013	0.013
	(2.97)***	(2.91)***	(2.98)***	(2.98)***	(2.92)***
Tender	0.014	0.014	0.015	0.014	0.015
	(2.95)***	(2.96)***	(2.97)***	(2.96)***	(3.03)***
Constant	0.017	0.016	0.016	0.016	0.012
	(1.02)	(0.97)	(0.96)	(0.96)	(0.70)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Observations	4134	4134	4134	4134	4134
Adjusted R^2	0.01	0.01	0.01	0.01	0.01

This table shows regression results. We regress three-day CARs of acquisitions announced in merger waves on an early acquisition dummy and control variables. Panels A and B show results using two merger wave classification methods:

P/E of S&P 500: each month from January 1979 to December 2006 is classified as a merger-wave month if the detrended market P/E of that month lies above the past five-year average.

M/B of stock market: uses the M/B ratio of the stock market—the median M/B ratio of all publicly listed firms—rather than the P/E of the S&P 500.

Early acquisitions are the first 10%, 20%, 30%, 40%, or 50% of deals announced in each merger wave. The remaining deals are classified as late acquisitions. Control variables include *Relative Size*—the transaction value divided by the market value of equity of the acquirer at the end of the month prior to the acquisition announcement (if the deal was announced in the first two weeks of a month, we use the market value of equity at the end of the month prior to that); *Cash*—a dummy variable that equals 1 if the acquisition was paid for in cash; *Mixed Payment*—a dummy variable that equals 1 if the acquisition was paid for using a mixture of cash and stock; *Tender*—a dummy variable that equals 1 if the acquisition was a tender offer. All regressions include year and industry fixed effects. Results are shown using one-digit SIC codes. Results are similar using 17 Fama-French groupings instead. Numbers in parentheses are *t*-statistics. ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4
Early acquisitions have larger increases in top management compensation than late acquisitions in merger waves

Percentage of deals classified as early acquisitions	Dependent variable: *Increase in Mean Top Management Compensation*				
	10%	20%	30%	40%	50%
Panel A: Increase in compensation regressions—merger wave classification based on P/E of S&P 500					
Early Acquisition	1.734	1.324	1.129	1.179	1.393
	(2.42)**	(2.54)**	(2.22)**	(2.23)**	(2.79)***
Relative Size	−0.901	−0.904	−0.851	−0.773	−0.714
	(−0.99)	(−1.00)	(−0.94)	(−0.85)	(−0.79)
Constant	0.296	0.302	0.299	0.161	−0.283
	(0.17)	(0.18)	(0.17)	(0.09)	(−0.16)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Observations	1159	1159	1159	1159	1159
Adjusted R^2	0.02	0.02	0.02	0.02	0.02
Panel B: Increase in compensation regressions—merger wave classification based on M/B of stock market					
Early Acquisition	0.091	0.112	0.824	0.722	0.618
	(0.18)	(0.27)	(2.26)**	(2.12)**	(1.85)*
Relative Size	−0.274	−0.275	−0.269	−0.313	−0.260
	(−0.35)	(−0.35)	(−0.34)	(−0.40)	(−0.33)
Constant	0.682	0.672	0.583	0.603	0.559
	(0.48)	(0.47)	(0.41)	(0.42)	(0.39)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Observations	936	936	936	936	936
Adjusted R^2	0.02	0.02	0.02	0.02	0.02

This table shows regression results. We regress the increase in top management compensation of early and late acquisitions announced in merger waves on an early acquisition dummy and control variables. Panels A and B show results using two merger wave classification methods:

P/E of S&P 500: each month from January 1979 to December 2006 is classified as a merger-wave month if the detrended market P/E of that month lies above the past five-year average.

M/B of stock market: uses the M/B ratio of the stock market—the median M/B ratio of all publicly listed firms—rather than the P/E of the S&P 500.

Early acquisitions are the first 10%, 20%, 30%, 40%, or 50% of deals announced in each merger wave. The remaining deals are classified as late acquisitions. The dependent variable is the percentage increase in mean top management compensation. Control variables include *Relative Size*—the transaction value divided by the market value of equity of the acquirer at the end of the month prior to the acquisition announcement (if the deal was announced in the first two weeks of a month, we use the market value of equity at the end of the month prior to that); year fixed effects; and industry fixed effects. Results are shown using one-digit SIC codes. Results are similar using 17 Fama-French groupings instead. Numbers in parentheses are *t*-statistics. ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4 contains the regression results based on the two merger-wave classification methods. As before, the numbers in parentheses are *t*-statistics. The regression results strongly support our third prediction. When merger waves are classified based on the P/E of the S&P 500 (panel A), the coefficient on the *Early Acquisition* dummy is positive and significant when we define early acquisitions as the first 10%, 20%, 30%, 40%, or 50% of all merger-wave acquisitions (*t*-statistics range from 2.22 to 2.79). When we alternatively classify merger waves based on the M/B of the stock market (panel B), the coefficient on the *Early Acquisition* dummy is positive in all cases, and significant when early deals are defined as the first 30%, 40%, or 50% of all merger-wave deals (*t*-statistics range from 1.85 to 2.26).

We perform four robustness checks to ensure that our results are not accidentally driven by other factors that may drive the documented increase in management compensation. These robustness checks are discussed in turn below, and Table 5 contains the regression results. For brevity, results on these robustness checks are shown only for the merger wave classification based on the P/E of the S&P 500, but we obtain similar results when we classify merger waves based on the M/B of the stock market.

Table 5
Early acquisitions have larger increases in top management compensation than late acquisitions in merger waves—four robustness checks

Percentage of deals classified as early acquisitions	Dependent variable: *Increase in Median Top Management Compensation*				
	10%	20%	30%	40%	50%
Panel A: Increase in compensation regressions—increase in median (rather than mean) compensation					
Early Acquisition	2.948	1.999	1.855	1.694	1.641
	(2.57)**	(2.39)**	(2.28)**	(2.00)**	(2.05)**
Relative Size	−1.558	−1.552	−1.472	−1.358	−1.306
	(−1.07)	(−1.07)	(−1.01)	(−0.93)	(−0.90)
Constant	0.244	0.283	0.259	0.092	−0.356
	(0.09)	(0.10)	(0.09)	(0.03)	(0.13)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Observations	1159	1159	1159	1159	1159
Adjusted R^2	0.01	0.01	0.01	0.01	0.01
Panel B: Increase in compensation regressions—control for the increase in sales (rather than relative size)					
	Dependent variable: *Increase in Mean Top Management Compensation*				
Early Acquisition	1.707	1.310	1.147	1.197	0.026
	(2.37)**	(2.49)**	(2.23)**	(2.23)**	(0.05)
Sales Increase	0.142	0.141	0.141	0.140	0.038
	(2.23)**	(2.21)**	(2.21)**	(2.21)**	(2.02)**
Constant	−0.430	−0.435	−0.671	−0.926	−0.781
	(−0.16)	(−0.16)	(−0.25)	(−0.35)	(−0.34)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Observations	1142	1142	1142	1142	920
Adjusted R^2	0.02	0.02	0.02	0.02	0.02
Panel C: Increase in compensation regressions—control also for method of payment and deal type					
Early Acquisition	1.737	1.316	1.104	1.169	1.388
	(2.42)**	(2.52)**	(2.17)**	(2.21)**	(2.78)***
Relative Size	−0.720	−0.722	−0.670	−0.585	−0.513
	(−0.77)	(−0.77)	(−0.72)	(−0.63)	(−0.55)
Cash	0.308	0.290	0.314	0.314	0.297
	(0.75)	(0.70)	(0.76)	(0.76)	(0.72)
Mixed Payment	0.154	0.112	0.117	0.114	0.038
	(0.23)	(0.17)	(0.18)	(0.17)	(0.06)
Tender	−0.617	−0.603	−0.540	−0.587	−0.599
	(−1.09)	(−1.06)	(−0.95)	(−1.03)	(−1.06)
Constant	0.205	0.222	0.189	0.061	−0.366
	(0.12)	(0.13)	(0.11)	(0.04)	(−0.21)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Observations	1159	1159	1159	1159	1159
Adjusted R^2	0.02	0.02	0.02	0.02	0.02

(*continued overleaf*)

Table 5
(Continued)

Percentage of deals classified as early acquisitions	Dependent variable: *Increase in Median Top Management Compensation*				
	10%	20%	30%	40%	50%
Panel D: Increase in compensation regressions—include a hi-tech dummy (rather than industry dummies)					
Early Acquisition	1.678	1.240	0.962	1.102	1.285
	(2.37)**	(2.39)**	(1.91)*	(2.10)**	(2.59)***
Relative Size	−0.440	−0.453	−0.402	−0.332	−0.272
	(−0.49)	(−0.50)	(−0.44)	(−0.37)	(−0.30)
HiTech	1.942	1.881	1.892	1.925	1.926
	(4.98)***	(4.82)***	(4.84)***	(4.93)***	(4.94)***
Constant	0.457	0.378	0.333	0.138	−0.098
	(1.78)*	(−1.40)	(−1.11)	(−0.39)	(−0.26)
Year fixed effects	Y	Y	Y	Y	Y
Industry fixed effects	N	N	N	N	N
Observations	1159	1159	1159	1159	1159
Adjusted R^2	0.03	0.03	0.02	0.02	0.03

This table shows regression results. We regress the increase in top management compensation of early and late acquisitions announced in merger waves on an early acquisition dummy and control variables using four alternative specifications that serve as robustness checks for the main increase in compensation results presented in Table 4. All panels show results using the *P/E of S&P 500* merger wave classification method: Each month from January 1979 to December 2006 is classified as a merger-wave month if the detrended market P/E of that month lies above the past five-year average. Early acquisitions are the first 10%, 20%, 30%, 40%, or 50% of deals announced in each merger wave. The remaining deals are classified as late acquisitions. Panel A shows results based on the increase in median (rather than mean) top management compensation. Panel B controls for the increase in sales (rather than the relative size of the deal). Panel C also controls for the method of payment (cash/mixed payment/stock) and deal type (tender/merger). Panel D includes a hi-tech dummy (rather than industry fixed effects). Each panel indicates which set of control variables is used. Control variables may include *Relative Size*—the transaction value divided by the market value of equity of the acquirer at the end of the month prior to the acquisition announcement (if the deal was announced in the first two weeks of a month, we use the market value of equity at the end of the month prior to that); *Sales Increase*—the increase in sales measured over the same period as the increase in compensation; *Cash*—a dummy variable that equals 1 if the acquisition was paid for in cash; *Mixed Payment*—a dummy variable that equals 1 if the acquisition was paid for using a mixture of cash and stock; *Tender*—a dummy variable that equals 1 if the acquisition was a tender offer; *HiTech*—a dummy variable that equals 1 if the acquirer is active in the high-tech industry; year fixed effects; and industry fixed effects using one-digit SIC codes. Numbers in parentheses are *t*-statistics. ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

The first robustness check examines whether our results may be driven by our focus on the *mean* increase in top management compensation. Panel A of Table 5 therefore focuses on the *median* increase in top management compensation. As before, the coefficient on the *Early Acquisition* dummy is positive and significant for all five early merger definitions. The second robustness check analyzes whether our results may be driven by differences in growth that are not captured by the relative size of the deal. Rather than including the relative size of the deal, panel B of Table 5 controls instead for the increase in sales over the same period as the increase in top management compensation.[26] The coefficient on the *Early Acquisition* dummy is positive and significant for four out of five early merger definitions. The third robustness check investigates whether differences in the method of payment and the type of the deal are

[26] Results are similar if the growth in total assets is used instead of sales growth.

driving our results and includes the same set of control variables as used in our *CAR* regressions. Panel C of Table 5 shows that even after controlling for the method of payment (cash/stock/mixed payment) and the type of deal (merger/acquisition), our main result still holds: the coefficient on the *Early Acquisition* dummy is positive and significant for all five early merger definitions. The last robustness check examines whether deals in the information technology industry may drive our results.[27] Instead of using industry fixed effects, panel D of Table 5 includes *HiTech*, a dummy variable that equals 1 if the acquirer operates in an industry with four-digit SIC Code of 3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, or 7373 (see Murphy 2003). As before, the coefficient on the *Early Acquisition* dummy is positive and significant for all five early merger definitions. We conclude that the increase in management compensation in earlier acquisitions is significantly larger than that in later acquisitions.

5. Conclusion

We have used a simple framework to show that envy among CEOs can generate merger waves even when the economic shock that initiates the wave is purely idiosyncratic to the first firm in the wave. The analysis produces numerous novel empirical predictions, which are summarized below. The first five predictions either appear to have support in the existing empirical literature, or have been confronted with the data in this article and found to have empirical support. The last four predictions await future testing.

1. Merger waves are more likely in bull stock markets than in bear stock markets. This follows from Proposition 4, and is a well-documented phenomenon, as noted earlier. This prediction is not necessarily unique to our theory, and is also implied by Rhodes-Kropf and Viswanathan (2004), for example.
2. Acquisitions undertaken during bull markets have lower bidder returns than those undertaken during bear markets. This follows from proposition 4, and is consistent with the finding in Bouwman, Fuller, and Nain (2009) that the long-term abnormal returns experienced by firms that acquire in bull markets are significantly lower than the long-term abnormal returns experienced by firms that acquire in bear markets. Again, this prediction can also be inferred from Rhodes-Kropf and Viswanathan (2004).

We believe that the remaining predictions are unique to our envy-based theory.

3. Earlier mergers in a merger wave display higher synergies than later mergers in the wave. Thus, the later mergers in a wave will have lower bidder

[27] This is done to account for the possibility that compensation practices and perceived synergy gains in this industry may differ significantly from others.

returns than earlier mergers. This prediction follows from Proposition 3, and our empirical tests support this prediction.

4. Targets in earlier acquisitions in a merger wave will be smaller than those in later acquisitions in the wave. This follows from Proposition 5, and our empirical tests support this prediction.
5. Earlier acquisitions in a wave will result in larger increases in top management compensation than later acquisitions in the wave. This prediction follows from Proposition 3, and our empirical tests support this prediction.
6. If we control for the dispersion in firm values, then the difference in merger activity across bull and bear markets largely disappears. This follows from Proposition 4.
7. An overall implication of our analysis is that greater transparency in executive compensation will elevate the likelihood of an envy-induced merger wave. However, the likelihood of an envy-induced wave is diminished if the CEOs of early acquirers have lower compensation than other CEOs. See the discussion in Section 3.
8. More envious CEOs are more likely to engage in takeovers and pay higher acquisition premiums than less envious CEOs. This follows from Proposition 1.
9. The proportion of acquisitions undertaken by nonenvious CEOs will be lower during merger booms than during other periods. This follows from Propositions 1 and 4.

We view envy as the key driving force behind the rich harvest of empirical predictions our analysis produces. While some are consistent with available evidence and the new evidence presented in this article, a few still remain to be tested. Testing some of these predictions will call for developing proxies for envy, which may open up an exciting new line of empirical research not only on mergers but also more generally on other corporate practices that are influenced by envy.

Appendix A

Proof of Lemma 1. The CEO of firm i acquires only if his utility does not decline from the acquisition. This utility depends on the wage increase which, in turn, depends on the value gain to the acquirer from the acquisition and the size of the target. Since value gains from acquisitions are independently distributed across firms, merger decisions are uncorrelated across firms. ■

Proof of Proposition 1. We shall show that there is a sequential equilibrium as described in the proposition with threshold wages defined by

$$U_i(\underline{W}^n;\theta^1,\ldots,\theta^{n-1}|\Theta^D=\Theta^{n-1}) = U_i(\underline{W}^n;\theta^1,\ldots,\theta^{n-1}|\theta^n=\{i\},\Theta^D=\Theta^n), n<D. \quad \text{(A1)}$$

$$\begin{aligned} U_i(\underline{W}^D;\theta^1,\ldots,\theta^{D-1}|\theta^D &= \{j|w(P^O+V_j^*)\geq \underline{W}^D, j\neq i\}-\Theta^{D-1}) \\ &= U_i(\underline{W}^D;\theta^1,\ldots,\theta^{D-1}|\theta^D=\{j|w(P^O+V_j^*)\geq \underline{W}^D\}-\Theta^{D-1}). \end{aligned} \quad \text{(A2)}$$

First note that the beliefs are derived from equilibrium strategies using Bayes' rule. To prove the sequential rationality of the equilibrium strategies, we first note that the threshold postacquisition wage $\underline{W}^n(\theta^1, \ldots, \theta^{n-1})$ is uniquely determined from (A1). We also note from (1) and (A1) that an acquisition by a CEO in equilibrium must be associated with an increase in the CEO's wage. Now, consider the CEO of a firm $i \in \{1, \ldots, N\}$ that has not acquired before date $n < D$ and whose CEO's postacquisition wage $W_i = w(P_i^M)$ exceeds or equals the threshold $\underline{W}^n(\theta^1, \ldots, \theta^{n-1})$. The equilibrium strategy of acquiring on date n yields the CEO greater utility than never acquiring because

$$\begin{aligned} U_i(W_i; \theta^1, \ldots, \theta^{n-1} | i \in \theta^n) &= U_i(W_i; \theta^1, \ldots, \theta^{n-1} | i \in \theta^n, \Theta^D = \Theta^n) \\ &\geq U_i(W_i; \theta^1, \ldots, \theta^{n-1} | i \notin \theta^n, \Theta^D = \Theta^n) \\ &\geq U_i(W_i; \theta^1, \ldots, \theta^{n-1} | i \notin \Theta^D). \end{aligned}$$

The equality follows because in equilibrium, acquisitions by other firms on future dates would result in CEO wages less than $\underline{W}^n(\theta^1, \ldots, \theta^{n-1})$ so these CEOs' wage increases would be less than that of firm i's CEO and hence would not affect the envy-related utility of firm i's CEO. If no other firm acquires on date n, the first inequality follows from (A1) and the assumption that $W_i \geq \underline{W}^n(\theta^1, \ldots, \theta^{n-1})$. If some other firms also acquire on date n, the inequality will still hold because of the increased attractiveness of a wage increase to firm i's CEO due to envy generated by the wage increases of other CEOs. The last inequality holds because the wage increases of CEOs of firms that acquire in the future may further reduce the utility of firm i's CEO if firm i does not acquire.

Note that the CEO of firm i does not gain by delaying his acquisition to a later date because it does not affect the CEO's wage increase. It may influence the acquisition decisions of other firms in the future, but these firms CEOs' will have lower wage increases, which means that they do not affect the utility of firm i's CEO.

Next, consider the CEO of a firm $i \in \{1, \ldots, N\}$, which has not acquired before date $n < D$ and whose postacquisition wage $W_i = w(P_i^M)$ is less than the threshold $\underline{W}^n(\theta^1, \ldots, \theta^{n-1})$. In order to show the sequential rationality of this CEO's equilibrium strategy, we prove the following intermediate results:

Result 1. The threshold postacquisition wage declines with time. That is, $\underline{W}^n(\theta^1, \ldots, \theta^{n-1}) \leq \underline{W}^{n-1}(\theta^1, \ldots, \theta^{n-2})$ and $\underline{W}^n(\theta^1, \ldots, \theta^{n-1}) < \underline{W}^{n-1}(\theta^1, \ldots, \theta^{n-2})$ if θ^{n-1} is nonempty. This follows because when some firms acquire on date $n-1$, the resulting envy strengthens the incentives of the CEOs of firms that have not yet acquired on date n.

$$\begin{aligned} &U_i(\underline{W}^{n-1}; \theta^1, \ldots, \theta^{n-1} | \theta^n = \{i\}, \Theta^D = \Theta^n) - U_i(\underline{W}^{n-1}; \theta^1, \ldots, \theta^{n-1} | \Theta^D = \Theta^{n-1}) \\ &\quad \geq U_i(\underline{W}^{n-1}; \theta^1, \ldots, \theta^{n-2} | \theta^{n-1} = \{i\}, \Theta^D = \Theta^{n-1}) - U_i(\underline{W}^{n-1}; \theta^1, \ldots, \theta^{n-2} | \Theta^D = \Theta^{n-2}) \\ &\quad = 0. \end{aligned}$$

Result 2. Consider arbitrary fixed realizations of postacquisition wages, W_k, for all other firms and two merger histories Θ^t and $\hat{\Theta}^t$ such that $\hat{\Theta}^n \subset \Theta^n$. If all firms that have not acquired by date n follow their equilibrium strategies, there will be fewer acquisitions following $\hat{\Theta}^n$ than Θ^n. That is, $\hat{\Theta}^D \subseteq \Theta^D$. The proof follows. The CEO of a firm considering acquisition on date $n+1$ will face greater envy following Θ^n than under $\hat{\Theta}^n$ and hence is more likely to acquire. This will lead to $\hat{\Theta}^{n+1} \subseteq \Theta^{n+1}$. The same argument can be repeated for date $n+2$ to show that $\hat{\Theta}^{n+2} \subseteq \Theta^{n+2}$, and continuing to argue this way establishes that $\hat{\Theta}^D \subseteq \Theta^D$. This proves result 2.

Now, we shall show that for a firm with $W_i < \underline{W}^n(\theta^1, \ldots, \theta^{n-1})$, the CEO's equilibrium strategy of not acquiring on date n yields the CEO at least as much expected utility as acquiring does. Suppose the firm acquires on date $n+1$ rather than date n. This change does not affect the expected utility of the CEO if the acquisition decisions of all other firms remain unchanged. However, from

result 2 above, the delay in firm i's acquisition will cause fewer other firms to acquire, leading to fewer wage increases of other CEOs, thereby increasing the envy-related expected utility of firm i's CEO relative to the case in which more firms acquire in response to firm i's acquisition on date n. Hence, firm i's CEO's optimal strategy is to not acquire on date n.

Finally, on date D, the CEOs of firms that have not acquired simultaneously determine whether to acquire or not. The strategy of the CEO of firm i, given the strategies of all other CEOs, is to acquire if the postacquisition wage exceeds a threshold. Further, the threshold should be the same for all CEOs because of symmetry. Thus, the equilibrium strategy for all CEOs is to acquire if the postacquisition wage exceeds the threshold $\underline{V}^D(\theta^1, \ldots, \theta^{D-1})$ given by (A2). There may be multiple interior solutions that satisfy the equality. If there is no interior solution, then $\underline{W}^D = -\infty$ or $\underline{W}^D = +\infty$.

To see that the threshold postacquisition wages $\underline{W}^n(\theta^1, \ldots, \theta^{n-1})$ or $\underline{W}^D(\theta^1, \ldots, \theta^{D-1})$ are decreasing in δ, note that increasing δ increases the CEO's marginal utility of wage and causes a larger increase in the right-hand side of (A1) than the left-hand side because the utility on the right-hand is calculated after the CEO's wage increase from an acquisition. This makes the acquisition more desirable to the CEO, so the equality of (A1) is obtained with a lower postacquisition CEO wage, and this is the wage at which the CEO is indifferent between acquiring and not acquiring.

To show that there are no other sequential equilibria, note that in the above proof, the sequential rationality of date-1 strategies was proved without making any assumption about future strategies, so all sequential equilibria must share the same date-1 strategy. Further, proof of sequential rationality of date-2 strategies does not depend on future strategies, so all sequential equilibria must share the same date-2 strategy. Continuing in this fashion establishes that there are no other sequential equilibria besides those mentioned.

Proof of Proposition 2. Consider firms i and j, and arbitrary fixed realizations of postacquisition wages, W_k, for all other firms, that is, $k \in \{1, \ldots, N\} - \{i, j\}$. In the rest of the proof, all probabilities will be conditional on these realizations of wages. Let G_i and G_j be the probability distribution functions for postacquisition CEO wages of firms i and j, respectively. Let θ^t, $1 \leq t < D$, be the set of firms that acquire on date t in equilibrium if firms i and j do not acquire. Then, the necessary and sufficient condition that neither firm i nor firm j acquires is that $W_i < \underline{W}^D(\theta^1, \ldots, \theta^{D-1})$ and $W_j < \underline{W}^D(\theta^1, \ldots, \theta^{D-1})$. Thus,

$$\Pr(M_i = M_j = 0) = G_i(\underline{W}^D(\theta^1, \ldots, \theta^{D-1})) \times G_j(\underline{W}^D(\theta^1, \ldots, \theta^{D-1})). \tag{A3}$$

Now, consider the event that firm j acquires but firm i does not. This requires that $W_j \geq \underline{W}^D(\theta^1, \ldots, \theta^{D-1})$. Let $\hat{\theta}^t$ be the merger history if firm j acquires before date D while all other firms follow their equilibrium strategy. Result 2 shows that more firms would acquire by date $D-1$ than in the merger history without the merger of firm j. That is, $\Theta^{D-1} \subset \hat{\Theta}^{D-1}$. Thus,

$$\underline{W}^D(\hat{\theta}^1, \ldots, \hat{\theta}^{D-1}) < \underline{W}^D(\theta^1, \ldots, \theta^{D-1}).$$

Then, the probability that firm j acquires but i does not is

$$\begin{aligned}
\Pr(M_i = 0, M_j = 1) &= \Pr(M_j = 1) \times \Pr(M_i = 0 | M_j = 1) \\
&= (1 - G_j(\underline{W}^D(\theta^1, \ldots, \theta^{D-1}))) \times G_i(\underline{W}^D(\hat{\theta}^1, \ldots, \hat{\theta}^{D-1})) \\
&< (1 - G_j(\underline{W}^D(\theta^1, \ldots, \theta^{D-1}))) \times G_i(\underline{W}^D(\theta^1, \ldots, \theta^{D-1})).
\end{aligned}$$

Now, the probability that firm i does not acquire, unconditional of the action of firm j, is given by

$$\Pr(M_i = 0) = \Pr(M_i = 0, M_j = 0) + \Pr(M_i = 0, M_j = 1) < G_i(\underline{W}^D(\theta^1, \ldots, \theta^{D-1})). \tag{A4}$$

The inequality follows from (A3) and (A4). Similarly,

$$\Pr(M_j = 0) < G_j(\underline{W}^D(\theta^1, \ldots, \theta^{D-1})). \tag{A5}$$

From (A3), (A4), and (A5),

$$\Pr(M_i = 0, M_j = 0) > \Pr(M_i = 0) \times \Pr(M_j = 0).$$

This shows the positive correlation between M_i and M_j. ■

Proof of Proposition 3. Suppose firm i acquires on date t while firm j acquires on a later date. The first part of the proposition follows from the following inequality based on the equilibrium in Proposition 1:

$$W_i = w\left(P_i^M\right) \geq \underline{W}^t(\theta^1, \ldots, \theta^{t-1}) > W_j = w\left(P_j^M\right).$$

The rest of the proposition follows from the fact that the wage $w(P_i^M)$ is increasing in P_i^M and hence increasing in $V_i^* = P_i^M - P^O$. ■

Proof of Lemma 2. The proof is identical to that of Proposition 1. ■

Proof of Proposition 4. We consider two scenarios. In scenario I, all firms have identical sizes and the threshold synergy value function for date t is $\underline{V}^t$. In scenario II, firms $N+1$ and $N+2$ differ in size from other firms and the threshold synergy value function for date t is $\hat{\underline{V}}^t$. The proof uses mathematical induction. Suppose $\Theta^t \subseteq \hat{\Theta}^t$ and $\underline{V}^t \geq \hat{\underline{V}}^t$ for $1 \leq t < n$. Then, we shall show that $\Theta^n \subseteq \hat{\Theta}^n$ and $\underline{V}^n \geq \hat{\underline{V}}^n$. Ignoring firms $N+1$ and $N+2$, result 2 in the proof of Proposition 1 shows that $\Theta^n \subseteq \hat{\Theta}^n$ and $\underline{V}^n \geq \hat{\underline{V}}^n$. Now consider the effect of firms $N+1$ and $N+2$ on the threshold synergy value in scenario II. A CEO comparing himself to the CEO of firm $N+2$ does not experience any envy because the CEO of firm $N+2$ has a lower wage. However, the CEO of firm $N+1$ has a higher wage in scenario II than in scenario I, strengthening each CEO's envy motive for a wage increase through an acquisition. This causes the threshold postacquisition wage to be even lower. Thus, we have established the induction step needed to complete the proof: $\Theta^n \subseteq \hat{\Theta}^n$ and $\underline{V}^n \geq \hat{\underline{V}}^n$. ■

Proof of Proposition 5. Consider two targets, j and k, with equal value gains, V_i, for acquirer i, and suppose target j is larger, that is, $P_j^* > P_k^*$. Then the utility of the CEO of acquirer i if he acquires target j is (using (1))

$$\begin{aligned} U_i^j &= u(w(P^O + V_i^*)) - d(P_j^*)M_i + \delta \sum_{l=1}^{N} \phi(w(P^O + V_i^*) - w_l) \\ &< u(w(P^O + V_i^*)) - d(P_k^*)M_i + \delta \sum_{l=1}^{N} \phi(w(P^O + V_i^*) - w_l) \\ &= U_i^k. \end{aligned}$$

This proves the proposition. ■

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