# Defensive Tactics and Optimal Search: A Simulation Approach

*Ronald J. Gilson*[*] *and Alan Schwartz*[**]

## Abstract

The appropriate division of authority between a company's board and its shareholders has been the central issue in the corporate governance debate for decades. This issue presents most vividly for defensive tactics: the extent to which the board of a potential acquisition target is allowed to prevent the shareholders from responding directly to a hostile bid. In the US today, the board's power is extensive; control largely lies with the board. Normative evaluations of current law face two obstacles. First, defensive tactics raise the social welfare question whether, or to what extent, these tactics deter ex ante efficient takeovers. This question cannot be answered empirically because the econometrician can observe bids but cannot observe deterred bids. The social welfare issue is also difficult to resolve using current analytical techniques because the market for corporate control is unusually complex: in it, financial and strategic buyers search for mismanaged companies or synergy targets; and some synergy targets search for acquirers. Turning to targets, the question which defensive tactics level maximizes shareholder welfare also is difficult to answer because of the qualitative nature of defensive tactics: Is a poison pill more or less privately efficient than a staggered board? What are the welfare consequences of combining a pill with a staggered board or a supermajority voting requirement? In this paper, we write a search equilibrium model of the market for corporate control and solve it by simulating plausible parameters for the variables of interest. Because we specify the number of ex ante efficient acquisitions that could be made, we can estimate market efficiency – the ratio of made matches to good matches – under legal regimes that are more or less friendly to defensive tactics. Also, we argue that the common metric among defensive tactics is time: the ability of various tactics to delay bid completion and thus reduce bidder, and thereby increase target, returns.

We have two important results: First, strong defensive tactics reduce market efficiency significantly. Our simulations suggest that the value of lost acquisitions is over $250 billion a year. Simulations are only suggestive and our simulated model likely overstates the welfare loss. Nevertheless, the result that defensive tactics cause economically significant welfare

[*] Stern Professor of Law and Business, Columbia Law School, Meyers Professor of Law and Business emeritus, Stanford Law School and European Corporate Governance Institute.
[**] Sterling Professor of Law, Yale Law School and Professor, Yale School of Management.
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losses would stand even if our magnitude estimate is halved. Second, the defensive tactics level that maximizes target shareholder welfare is materially higher than the level that maximizes social welfare. These results also support a methodological claim: equilibrium analysis can illuminate regulatory issues regarding the market for corporate control.

## 1. Introduction

The central issue in corporate governance for the last 35 years has been the extent to which a corporation's performance should be exposed to capital market review through shareholder action. At stake is the relative power of shareholders and the board of directors: when, over the board's objection, should the law permit shareholders to accept the proposal of an outside agent to purchase the company, change the company's operating or financial strategy, or change management? The type of outside agent and the mechanisms through which these agents act have evolved in response both to changes in the capital market and changes in the problems confronting companies. Boards have responded to the increased external exposure that the new mechanisms create by deploying defensive tactics that seek to transfer to boards the power to accept or reject outside proposals. In this article, we return to two key questions that the earlier debate never answered, in no small measure because the courts effectively muted the issue by giving boards very broad powers to adopt effective defensive tactics. These questions are: (i) What is the socially optimal level of defensive tactics in the corporate control market; and (ii) What is the privately optimal level of defensive tactics for target shareholders in that market.[1] We address these questions by simulating a model of sequential acquirer search.

### 1.1 The Dynamics of External Capital Market Exposure

Junk bond financing was the initial mechanism that permitted the market to exert strong pressure on companies. Capital market participants used junk bonds to finance a spate of hostile takeovers in the 1980s. Shleifer & Vishny (1990). These takeovers dismantled many unsuccessful 1970s era conglomerates, but they also gave rise to a responsive defensive arsenal, including the poison pill. A

[1] The terms of the earlier debate are set out in Easterbrook & Fischel (1981), Gilson (1981 & 1982); Bebchuk (1982) & 1988); Schwartz (1986) & (1989).

hostile bid could not be accomplished with a pill in place, and only the board of directors could withdraw it. The pill plus a staggered board required a potential acquirer to win two elections in order to replace a majority of the directors, withdraw the pill and go forward with the hostile bid. More recently, the intermediation of equity and the resulting concentration of equity holdings in institutional investors, importantly including public mutual funds, allowed a new category of governance participants – styled "activist investors" – to propose changes in a company's operating or financial strategies or the company's sale. (Gilson & Gordon 2013) Activists confront companies that resist with a threat of a proxy fight, made credible by institutional investors' large equity holdings and their having participated in forcing many potential targets to eliminate staggered boards.[2] Because the activists' strategy catalyzed the increased equity held by institutional investors, such activist campaigns became possible at companies whose size would have been a complete defense to 1980s-style leveraged takeovers. Activists today, however, typically do not attempt to buy companies, but rather seek minority representation on a company's board.[3]

Predictably, companies' expanded exposure to activist campaigns induced defensive responses directed at elections rather than forced sales.[4] The governance debate thus reflects a dynamic interaction of capital markets, external governance actors, boards, management and, importantly, courts. The Delaware courts' broad approval of poison pills, even when coupled with staggered boards,[5] helped push governance activity away from hostile takeovers and toward activism. Yet as market conditions and opportunities continue to change, hostile takeovers may be making a comeback despite the continued difficulty of buying a company when its board prefers not to sell.[6] More concentrated target stock ownership by institutional investors reduces the costs of running proxy fights, and the reduced incidence of staggered boards speeds a hostile bidder's effort to assure the bid's consideration by shareholders.

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[2] See Third Point LLC v. Ruprecht, 2014 WL 1922029, for the use of a pill in the context of an activist driven proxy fight.

[3] Activists are constrained by their need for institutional shareholder support. If an activist sought to replace an entire board, the institutional shareholder would be a buyer, in effect investing in the activist's vision for the company. These shareholders seldom sign on to that extent.

[4] See Gilson and Schwartz (2001). See Third Point v. Ruprecht, supra note 2, for the use of a pill designed to address an activist campaign. A recent description of hedge fund activism is Coffee and Palia (2015).

[5] Air Prods. & Chems, Inc. v. Airgas, Inc., 16 A3rd[3d] 48, 114-115 (Del. Ch. 2011).

[6] See "Hostile Bid Feeds Frenzy for Deals", WSJ August 5, 2015, p.1.

Despite these dynamic changes in the actors, mechanisms and targets of external capital market activity, the basic normative question that the corporate governance debate should answer is the same: what is the appropriate division of authority between shareholders and boards for resolving external claims that the company should be sold or its strategy changed? This question is posed most directly by hostile takeovers, which are our subject. Control over the crucial decision whether to sell the company would reside with target shareholders if they could accept or reject hostile bids. When the target has effective defenses, however, the board decides whether to allow shareholders to exercise this power.

### 1.2 **Standard Justifications for Defensive Tactics**

The standard justification for giving the board discretion to prevent shareholders from accepting a hostile offer has two tracks. First, defensive tactics permit the board to bargain more successfully over the division of rents between the bidder and the target shareholders. The second track is a more extreme form of the first. Let a board honestly believe that the target's value will materially increase (discounting for time and risk), but the board is unable credibly to disclose either to the bidder or to the market the basis for this belief. The board, Delaware courts believe, should then prevent shareholders from acting on an offer, in one case to increase the price to reflect the target's actual value and in the second to block a sale until the board can credibly convey its view of the target's real prospects.[7]

These justifications assume that a target's board is a faithful fiduciary. A particular board, however, may be acting disloyally; its goal in adopting defensive tactics is to block takeovers in order to keep current directors and management in place rather than to benefit shareholders.[8]

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[7] According to Delaware courts, a takeover bid "substantively coerces" target shareholders when it offers them the opportunity to accept a bid that may be below the "true" value of the company. This view is reviewed in Gilson and Kraakman (1989). Fox, Fox and Gilson (2016) evaluate empirically where, if anywhere, substantive coercion might exist. Boards that believe that every bid likely will be below a target's true value can effectively opt out of the market for corporate control by adopting very strong defenses. In the model below, these are "noise firms" whom searching acquirers cannot buy. See text at 26 and note 26.

[8] The same alternative can be framed in behavioral terms rather than in terms of disloyalty. Defenders of the board's power to block an offer also argue that the market is myopic – that it discounts the future excessively. Conversely, defenders of the shareholders' right to decide argue that the board and management are "hyperopic": they fail to discount their future plans sufficiently. Either position is consistent with some combination of behavioral biases. See Gilson (2001).

Because the board's "real" motivation may be difficult to observe and impossible to verify, courts ultimately have reduced their inquiry into motive to a rule-like assessment of whether a defensive tactic is either "draconian" or "preclusive" of a hostile bid.[9] And while a poison pill would preclude a hostile offer, the Delaware Supreme Court held that the pill is not preclusive if defensive tactics "would only inhibit" a proxy fight to remove target directors, whose successors then could eliminate the pill. More precisely, the Supreme Court stated that a defensive tactic is preclusive only if it makes a successful proxy fight "mathematically impossible or realistically unattainable."[10]

### 1.3 **The Open Questions**

The resurgence in hostile offers, as well as defensive efforts to block activist proxy fights, reopen the earlier debate, which was not so much settled as abandoned in the face of the broad discretion courts gave boards of directors. The key questions remain. First, what level of defensive tactics maximizes social welfare? Second, what level of defensive tactics maximizes target shareholder welfare? In this paper, defensive tactics maximize social welfare when they maximize the number of ex ante efficient acquisitions the capital market makes.[11] Defensive tactics maximize shareholder welfare when they maximize the target shareholders' expected return from a possible sale of the company.

Before sketching the positive issues that these normative criteria raise, we note that defensive tactics unequivocally disadvantage potential acquirers because they eliminate a maximizing strategy: to buy a target with a hostile bid. Before defensive tactics were in place, a

[9] Unitrin v. American General Corp., 651 A.2d 1361 (Del. S.Ct.1995).
[10]id., supra note 9, at 1388-89.
[11] Two other social welfare measures appear in the literature. First, the credible threat of a takeover may cause target managers to maximize target returns either by performing better or consuming fewer private benefits. This possibility has theoretical support but has been difficult to test empirically. A recent paper conducts a rigorous test, however, and reports: "…we find strong evidence that the enactment of M&A Laws [which reduce barriers to takeovers] increases the sensitivity of CEO turnover to poor performance…. we provide evidence that an external market for corporate control, when available, can be an effective substitute for internal-governance mechanisms." Lel and Miller (2015) at 1590. Because increasing the ex ante probability of acquisitions increases the pressure on managers to maximize, the welfare measure in text is consistent with the incentive increasing measure. Second, a global social welfare measure for corporate governance is the net gain to all those doing business with the company, thereby requiring a netting of gains and losses among, for example, customers, suppliers, employees and shareholders. See Magill, et al (2015); Bolton, Becht, & Roell (2003). We do not address this second measure here.

firm that discovered an attractive target could, depending on the opportunity a particular target presented, pursue one or more of these strategies: (i) take an equity position in the target and suggest that the target alter its business strategy; (ii) request board seats; (iii) if strategies (i) and (ii) do not avail, run a proxy contest for board membership; (iv) offer to buy the target in a friendly acquisition; and (v) make a hostile bid. Today, defensive tactics constrain the hostile strategy, which reduces the utility of firms that would have used it. Because a firm's gains are non-decreasing in the size of the firm's strategy set, defensive tactics thus reduce acquiring firms' expected welfare.[12] The question, then, is whether what disadvantages acquirers – strong defensive tactics -- also disadvantages society and target shareholders.

The Delaware courts have not pursued the social welfare question, however. The fiduciary duty of directors runs to the company and its shareholders, not to shareholders generally. Hence, when the courts evaluate defensive tactics, they pay little attention to the impact of their decisions on the shareholders of other companies. The courts' largely exclusive focus on shareholders of the target company thus elides, rather than responds to, the social welfare objection. Indeed, should a board agree to consider acquisition offers, Delaware law requires the board to maximize the price.[13]

However, the social welfare objection to defensive tactics ignored by the Delaware courts – that these tactics would reduce the number of hostile bids – has a difficulty of its own: reducing target acquisition prices to target shareholders' reservation prices may itself be inefficient. Earlier economic analyses assumed that the corporate control market was similar to ordinary markets: there were passive sellers – the potential targets – and active shoppers – the potential acquirers. In the standard search model, shoppers police the market; hence, reducing the return to shopping would yield noncompetitive equilibria. Defensive tactics reduce the return to shopping because they raise the target's price. Therefore, the conclusion that

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[12] A poison pill also constrains the potential for a successful proxy fight because it limits the percentage of a target's stock that can be purchased without its board's consent.

[13] *Revlon, Inc. v. MacAndres & Forbes Holdings*, 506 A.2d 173 (Del. S. Ct. 1986). Similarly, a board may not be passive if it believes shareholders will tender into an underpriced offer. Unocal Corp. v. Mesa Petroleum, 493 A. 2d 946 (1985).

defensive tactics should be banned appears to hold in an equilibrium analysis.[14] The premise of this efficiency argument for prohibiting defensive tactics is questionable, however, because the corporate control market is atypical. To be sure, there are acquirers that search for targets and there are passive targets, but there also are active targets that search for acquirers and "noise firms" that appear to be targets but are not.[15] The corporate control market thus is partly a traditional active buyer/ passive seller market and partly a noisy matching market with perfectly transferable utility. [16]

Standard matching models, however, also fit the corporate control market poorly because, as just said, some potential sellers – the targets -- do not search; indeed, a subset of the "sellers" are passive because they do not want buyers to find them, and may become active resistors if found.[17] Also, in matching models how the agents split the match surplus is either exogenous or determined by bargaining after searching agents find each other. In contrast, in the corporate control market, defensive tactics (and their effectiveness) affect how the surplus from an acquisition – the amount by which the post-transaction value of the target is expected to exceed the target shareholders' reservation price – is split ex post. Firms commonly choose these tactics before they see bids.

Importantly, potential acquirers anticipate how defensive tactics affect the return from acquisitions, and this, in turn, affects how intensely these agents search for good matches. Just as defensive tactics reduce acquirer search for targets by reducing acquirer returns, banning defensive tactics may reduce target search for acquirers by reducing target returns. A possible target may not search intensively for a potential buyer if the buyer could purchase the target directly from the target shareholders at their reservation price. The buyer could pay this

[14] Galenianos and Kircher (2012) provide a general review of search models in which one side searches and the other side sets prices. Schwartz (1986) applies this genre of model to the corporate control market.

[15] A noise firm is a bad match in a particular period for all of the acquirers who search in that period. Note 26, infra, characterizes noise firms more precisely. We note here that noise firms dilute the effectiveness of acquirer search. To see why, let a potential acquirer plan to search three potential targets. Learning that one of the searched firms is not in play wastes the costs of analyzing it: the searching firm in effect has considered only two "live" prospects.

[16] Utility is perfectly transferable when, as here, agents maximize monetary returns and engage in trade.

[17] A standard matching model has the agents on each side – sellers and buyers or prospective marriage partners – searching to buy or combine with the other side.

relatively low price if the defensive tactics that encourage negotiation are absent. Because defensive tactics influence the searching activity of both sides of the market, there is a question whether acquirer and target search are substitutes -- acquirers search more when targets search less – or complements – acquirers search more when targets search more. The unsettled nature of this question also explains why the socially optimal level of defensive tactics remains an open question.

The target shareholder welfare question also is open. A loyal target board should want to maximize bid price conditional on there being bids but also want to maximize bid probabilities, which defensive tactics affect. Because these goals conflict, the "loyal board problem" is to maximize the tradeoff between bid price and bid frequency – that is, to maximize expected acquisition gains. As yet, the solution to this tradeoff has not been characterized analytically.

Empirical research on defensive tactics has been extensive, but it has not established which level of defensive tactics maximizes social or private welfare. Regarding the social welfare measure, the econometrician can observe concluded and failed bids for targets under an existing legal regime. She cannot observe the total number of possible good matches there were in that regime, however. Hence, she cannot estimate how well, in terms of making matches, a current regime is doing, nor could she test whether there would be more or fewer good matches under an alternative legal regime. The private welfare question has been hampered by the qualitative aspects of defensive tactics. A poison pill, for example, permits a target board to reject bids and to constrain a proxy fight initiated to remove a pill. Whether this power is relatively more important than a staggered board, or whether less important than a combination of the two, in maximizing the target shareholder tradeoff between bid size and bid frequency is difficult to measure without a common metric for comparing various defensive tactics and their combination across different circumstances.[18]

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[18] Straska and Waller (2014) extensively review the literature concerning the effect on shareholder wealth of antitakeover provisions. According to these authors, the literature reaches no firm conclusions. Thus, they suggest, as a question for future research (at 953): "Does an optimal value-maximizing number of antitakeover provisions exist?" The debate is further complicated by uncertainty over the actual effect of familiar defensive

1.4. **Methodology and Results**

In this paper, we simulate a search equilibrium model of the market for corporate control to identify the socially and privately optimal defensive tactics levels, and to inquire into the extent to which these normative goals conflict. In general, two efficiency measures are applied to matching markets. First, do agents' matches maximize surplus? Second, is the market "match efficient"? To understand what is meant by match efficiency, let m represent the number of ex ante efficient matches that exists in a market at time t. Agents in the market can make $n \leq m$ matches. Letting $\sigma$ denote the ratio n/m, the market is perfectly match efficient if $\sigma = 1$; actual sigmas reveal the efficiency shortfall because they reflect the matches that agents make compared to the good matches it was possible for agents to make.

We focus on the match efficiency question. Regarding motivation, we assume that semi-strong efficiency holds: the market price approximates a target's stand-alone value. It follows that every acquisition is ex ante efficient: the bidder believes that it will realize surplus at the bid price and the target's shareholders, or its board, will reject bids that do not exceed the target shareholders' reservation price, which we saw in the previous section exceeds its stand-alone value. If every actual match is ex ante efficient, the relevant question is how close the market comes to making all of the matches there are.[19]

Relating this discussion to the prior analysis, search intensity is an increasing function of the expected return to searching. Here, an agent's expected return is a function of how the surplus from an acquisition is split. [20] Because defensive tactics affect the split, we solve for

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tactics and by what appear to be errors in the coding of the data bases typically used to identify companies' existing defensive tactics. See Klausner (2015); Catan and Kahan (2016) and Larcker, et al (2016).

[19] Because searching for and buying companies are costly, the corporate control market is unlikely to be perfectly match efficient. The issue is how close the market comes under strong and weak defensive tactics legal regimes. Regarding our assumption that matches are ex ante efficient, Li, et al (2015)'s study of M&A contests claims that "On average, … the M&A market usually allocates resources efficiently.". A recent review of private and public company acquisitions also reported: "We find that acquisitions are efficiency improving, both on and off the [merger] wave." Makismovic, et al (2013) at 2179. Duchin and Schmidt (2013) is partly consistent with these papers: it finds favorable results for mergers in general but less favorable results for on wave mergers. Match efficiency is related to investment efficiency because agents may invest in anticipation of making matches. We do not investigate investment efficiency. For a complex and thorough treatment, see Noldeke and Samuelson (2015).

[20] A recent paper estimated that target resistance explains 74% of the premium in single bidder contests, with which we are primarily concerned. See Dimopoulos and Sacchetto (2014). Hence, it is plausible to suppose that

the optimal acquirer search intensities that various defensive tactics regimes induce. These intensities determine the number of matches the acquirers make. As an illustration, let there be 20 ex ante efficient matches in a market. If acquirers make ten matches under a legal regime that is unfriendly to defensive tactics and 12 matches under a more friendly regime, the former regime is less match efficient than the latter: (a σ of .5 is smaller than a σ of .6). Hence, if actual matches are as in the illustration the corporate control market may be more match efficient with defensive tactics than without them.

Determining match efficiency in real markets is impossible because, as said, the analyst cannot observe the number of efficient matches that could have been but were not made. There are two ways to address the unobservability problem. The first is to solve a model of the corporate control market analytically and then see whether agents' observed behavior is consistent with optimal behavior in the model. Even under this approach, however, the analyst still could not observe a key parameter -- the number of possible good matches. Also, such a model has not been solved, and seems difficult to do.

We thus proceed in the second way: we write a model of the corporate control market and "solve it" with simulations. The simulations are described in detail in Part 2; we introduce our methodology here. First, we create sets of acquirers and targets and characterize them. Targets either are companies whose stand-alone value can be improved by acquirer imposed changes in strategy or management (financial acquirer opportunities), or targets whose value is increased by combining their activities with those of the acquirer (synergistic acquirer opportunities). Acquirers are of parallel types: an acquirer either has the managerial capacity to improve a target's strategy or performance (for example, a private equity firm), or has a business that when combined with that of the target will increase the value of both (a synergy acquirer).

We next specify how acquirers and targets search for good matches. Both agents search sequentially, analyzing potential targets until either the agent makes a match or the marginal

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potential acquirers consider the effect of defensive tactics on their likely share of acquisition surplus when choosing search intensities.

cost of further search would exceed the gain. The gain is the share of the acquisition surplus the agent expects to realize from a match, so we estimate the split a defensive tactics unfriendly regime generates and the split a more defensive tactics friendly regime generates. Because we have specified the number of good matches in the simulated market, we can use the search intensities that search costs and these splits induce to find how many matches acquirers would make under the two legal regimes. The regime that generates the highest sigma – the highest ratio of made matches to total matches -- is the more match efficient regime.

To be sure, simulation results are only suggestive, but if the parameters are plausible and the results are intuitive, some progress has been made. Simulating our model suggests that the current legal regime, under which defensive tactics permit a target to acquire a large share of an expected acquisition surplus, is match inefficient relative to a regime that permits the target to realize a smaller share. In particular, the surplus split under our assumed defensive tactics-friendly regime yields approximately 65% of the total matches that could be made while our assumed defensive tactics unfriendly regime yields approximately 93% of the possible matches. In 2014, the deal value of U.S. public company acquisitions was $1.04 trillion.[21] That the current legal regime may reduce the number of acquisitions by approximately 28% per period thus is economically significant.

A simple intuition, set out more fully below, explains this result. *All* of the acquirers search in the corporate control market but only a subset of targets search. Therefore, though acquirer and target search turn out to complement each other, total acquirer search intensity falls by much more than total target search intensity increases as the legal regime shifts surplus away from the acquirers and toward the targets. The consequent reduction in net search intensity causes the market to make net fewer matches.

Turning to shareholder welfare, the difficulty, as noted above, has been the lack of a common metric by which to assess various defensive tactics. A common metric does exist, however: *time*. Bargaining power declines in a player's impatience. Acquirers thus are at a disadvantage relative to targets because acquirers commonly are less patient. An acquirer's

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[21] Li, et al. (2015).

payoff – its surplus share – declines as the time increases from finding a possible target to buying it. The acquirer may have to tie up resources for a longer period, focus executive time on a deal for a longer period, pass up other business opportunities, negotiate more intensively with the target, and confront a competitor for the acquisition opportunity. In addition, the target has the opportunity to continue a value decreasing strategy. This not only reduces target value but also may constrain the acquirer's ability to integrate the firms. Defensive tactics permit targets to delay. A poison pill can delay an acquisition for up to a year because it can take that long to win a proxy contest; a poison pill with a staggered board can delay an acquisition for two plus years because the acquirer must win two proxy contests, which in practice may block the offer.[22] As a consequence, there is a positive relationship between the delay facilitating property of a defensive tactic and the share of an acquisition surplus the tactic permits the target to realize.

We argue below that an internal solution to a target board's maximization problem exists: that is, for each target there is a delay facilitating defensive tactics level that maximizes the target's expected return from a sale of the company.[23] The simulations we do to test this claim yield three results: (i) a target's expected return, as a function of the defensive tactics level it chooses, is maximized when targets realize between sixty and sixty five percent of acquisition surplus; (ii) the evidence suggests that actual targets choose defensive tactics levels only slightly higher than these maximizing splits. Hence, many actual boards may be faithful fiduciaries regarding sales of the company; and (iii) there is a conflict between individual and collective rationality; the defensive tactics levels that are optimal for potential targets much exceed the levels that are optimal for society. In addition, some firms today apparently are choosing defensive tactics levels that approach corners: those tactics would be privately as well as socially inefficient.

We do not interpret our results regarding the match dampening effect of defensive tactics and the incentive of loyal target boards to choose tactics that are socially inefficient as supporting a clarion call for regulatory action. Our simulated equilibria and our target

[22] See *Airgas*, supra note 5, in which the court remarked that no one has seen a two-election effort.
[23] Gilson (1981) provides an early statement of this position.

shareholder welfare analysis are intended to restart the debate over defensive tactics rather than end it, although we note that both commentators and respected courts have questioned giving target boards very broad freedom to deploy defensive tactics. Rather, we want to situate defensive tactics in the larger debate about the desirability of shareholder control. Our preliminary results suggest that defensive tactics, considered in isolation, are unequivocally bad for acquirers; good for target shareholders at some levels, but not at higher levels; and can materially reduce efficiency in the market for corporate control. The ability of activist investors today to influence corporate policy without a takeover may ameliorate some of these bad effects because the concentration of equity through intermediation makes effective defensive tactics against activists more difficult, at least for now.[24] But potential targets still have weapons to use against activists, and may develop more with time.[25] Thus, we suggest that the defensive tactics issue should again occupy a prominent place in the corporate governance debate. Finally, and regarding regulation, there are hints that as the level of institutional ownership has increased, Delaware courts may give boards less room to protect shareholders from making mistakes than under the current substantive coercion regime, Gilson & Gordon (2015); Jacobs (2012 ). This legal position, in turn, would be consistent with an interior solution to the level of allowable defensive tactics. Interestingly, the position tracks a view that the Delaware Chancery Court advanced in the mid-1980s only to be rejected by the Delaware Supreme Court in the mid-1990s, a pattern that we consider in Part 3.

Part 2 below analyzes match efficiency in the market for corporate control; Part 3 analyzes shareholder welfare, highlights the conflict between private and social efficiency and addresses normative objections to our analysis. Part 3 then closes with an analysis of the early Delaware Chancery Court legal regime and compares that regime to the current regime. Our analysis here suggests that the Delaware courts had it right the first time. Part 4 concludes. The Appendix describes the coding and search algorithms.

[24] The Wall Street Journal reports that in 2015 activist investors launched 360 campaigns against companies and secured board seats in 127 of those campaigns, both of which were records. See David Benoit, "Activists Win Seat at the Table", WSJ Dec. 26-27 (2015), section 1, at pp. 1, 8.

[25] See Third Point v. Ruprecht, supra note 3.

## 2. The Market for Corporate Control

### 2.1. The Parameters and the Model

We simulate a one period search equilibrium model of the market for corporate control in order to estimate the effect defensive tactics have on market efficiency. In the model, would be acquirers search for targets to buy and a subset of would be targets searches for acquirers. Because there is no data on important variables of interest, such as the number of good matches that could be made in a period or the actual proportions of financial and strategic buyers in the market, the utility of the simulations turns on the plausibility of our assumptions about the nature of the agents, their assumed strategies, the costs of search and so forth. We thus begin by setting forth our simulation parameters and the reasons for them.

Regarding market participants, we have two hundred risk neutral agents, one hundred thirty four of whom are acquirers. Sixty four of the acquirers – the strategic buyers -- are searching for synergy matches; the other seventy acquirers – the financial buyers – are searching for mismanaged firms to improve. There are twelve possible synergy sellers who do not search for acquirers – the passive targets; twelve active possible synergy sellers who search for acquirers – the active targets; and thirty mismanaged passive targets. A target is defined to be a live prospect: a firm that a searching acquirer believes it can profitably acquire. Hence, there are fifty four ex ante efficient transactions in the relevant period. Wasted searches also are common, which implies the existence of a nontrivial number of noise firms, who will not match with anyone. We let there be twelve such firms.[26]

[26] We need a large enough agent population to get possibly meaningful results. The ratio of agent types to each other is more important than the absolute number of agents. Recall that noise firms are bad matches for every acquirer. A noise firm may have some unique characteristic but the more likely explanation is that the firm has chosen a defensive tactics level such that its price is above the expected limit price of any searching acquirer. A firm can choose a very high defensive tactics level either because its board wants to entrench itself and its management or because the board believes that a significant portion of the firm's value is hidden. In the latter case, the board fears that an acquirer may succeed with a bid that is below the firm's true value. Burkart and Raff's (2015) model has shareholders permitting managers to make ex ante inefficient acquisitions (that generate private benefits for the managers) in order to induce the managers to exert high effort in earlier periods. In our model, acquirers maximize expected utility by making matches. We do not consider the Burkart and Raff possibility because its empirical significance is unclear.

Every acquirer could find a target if there were as many targets as there were acquirers. Because an acquirer has to conduct a search to distinguish a noise firm from a target, on our parameters there is about an 18% probability that an acquirer will hit a noise firm with one search. Financial buyers tell us that they have to explore many firms to find a firm that is sufficiently badly run to justify purchasing it. This implies that searching one firm is relatively unproductive. Adjusting for noise firms, the effective ratio of mismanaged targets to financial buyers in our simulations is .35. Search should be relatively more efficient for synergy acquirers because they probably have a better idea of where to look for good partners. Again adjusting for noise firms, the effective ratio of synergy targets to strategic buyers is .54. In the model, the number and types of market agents are exogenous; the *amount of search* in which the agents engage is endogenous; it is a function of costs and expected gains. [27]

Importantly, every acquirer searches but relatively few targets search. Targets plagued by agency costs -- mismanaged targets -- will not search for acquirers because the boards and managements of these targets prefer not to be found. Targets that would be good synergy matches either can search for acquirers or be passive. We assume that half of the synergy targets do not search but will consider sale if found, for two reasons. First, search for synergy partners is a different skill set than running a business (Gilson 1982); many firms in the normal course specialize in running their businesses, but will consider a good offer should one appear. Second, a synergy seeking firm can either want to buy another firm or sell itself to another firm. Success in a synergy motivated acquisition requires both search and implementation skills. We classify synergy seekers that want to buy – those who believe they have implementation skills – as acquirers. Consistent with this framing, the impressionistic evidence is that non-distressed firms commonly do not attempt to sell themselves. Finally, targets cannot implement acquisition *programs* because a target can only sell itself once, but some acquirers make

[27] Acquirers search because they have made a prior decision that the right acquisition would be profitable. An acquirer buys at most one firm. As the Introduction suggests, and Part 3 remarks, an activist has a number of available strategies to affect potential target behavior. We focus on purchases here because we want to characterize the market for acquisitions.

repeated acquisitions.[28] Summing up, we assume that a relatively small subset of potential targets is searching for acquirers. [29]

There are two search strategies in the literature: sequential search, in which the agent continues to search until the marginal cost of another search equals the expected marginal gain, which would be a lower price; and fixed sample size search, in which the agent chooses a sample size over which to search before beginning, and buys at the best price her sample reveals. We simulate a variant of sequential search because fixed sample size search is unrealistic in the corporate control context. An agent searching pursuant to a fixed sample size strategy will return to an earlier draw if it yielded the lowest price. Fixed sample size models thus assume that sellers do not alter their prices after buyers visit them. In contrast, a target that is realistically searched will know that it is in play. The target then may take steps to improve its position, such as adopting a stronger defense or finding another bidder. The corporate control searcher therefore cannot return to the "same" firm that it visited earlier. As a consequence, we assume that agents search sequentially: that is, until either the agent finds a match or a next search would yield negative expected gains. In the former case, the agent bids for the match; in the latter case, the agent exits.[30]

The number of searches agents make is a function of search costs and prospective gains. We assume that it costs about two percent of the match surplus to make one search, which is consistent with the data about the ratio of transaction costs to acquisition gains. Costs are assumed to be convex, so searching two firms costs a searcher more than would just doubling the cost of searching one firm.[31] The gains from search are more complex to estimate. Beginning with timing, targets choose defensive tactics levels before search begins. The

[28] See Golubov, et al (2015); Aktas, et al (2013).
[29] Phalippou, et al (2015) defines a "target" as a firm that makes serial acquisitions in order to prevent being acquired itself. In our model, a firm that makes serial acquisitions is an acquirer.
[30] In pure sequential search, the searcher ends search either when, given the market distribution, she believes that the present deal is better than the deal further search would uncover or when the next search would yield negative utility. In our simulations, the agent stops searching either when she finds a suitable target (a synergy target for a synergy searcher) or, as in the standard model, the next search would yield negative utility.
[31] The matlab code sets the cost of searching over one potential target as minus 2 utils. Search costs increase as the agent searches more possible targets under the rule: search costs = -2- - (sample size)/10)$^2$ + .01. Our cost assumption also permits us to specify match gains.

acquirers next choose search strategies. An acquirer does not know the defensive tactics level at a particular firm without searching that firm but acquirers are assumed to know the market distribution.[32] Acquirers also are assumed to know the number and type of targets that constitute the market's selling side.

The gain from search is the expected fraction of the surplus from a match that the searching agent expects to realize. Here, data limitations require us to make some possibly strong assumptions. Initially, the empirical observer cannot conveniently observe actual surplus splits. We assume that the surplus split favors targets in the current defensive tactics regime because these tactics are adopted just in order to stop acquisitions or to raise acquisition prices. We estimate an acquirer's expected surplus as follows: Let p be the (correct) pre-bid market price of the target; p thus is the target's stand-alone value. The acquirer's value for the target is v and the winning bid is b. We let $b = (1 + \alpha)p$, where $0 < \alpha < 1$ is the premium necessary to induce shareholders to tender, and $v = (1 + \beta)p$, where $0 < \beta \leq \infty$ reflects the acquirer's expected value as a function of the target's pre-bid price. A bidder's return is $v – b$, or $(1 + \beta)p – (1 + \alpha)p = p(\beta - \alpha)$. The match surplus is the bidder's value less the pre-bid price: $p(1 + \beta) – p = p\beta$. The acquirer thus expects to realize $\frac{p(\beta-\alpha)}{p\beta} = \frac{\beta-\alpha}{\beta}$ of the surplus from a completed transaction.

This is not the expected value of a search, however. Two recent studies are illuminating here. One estimated the fraction of initial bidders that acquire targets as .9, but the fraction falls substantially if other bidders enter.[33] The other study estimated the fraction of single bidder contests that succeed as .74 and the number of auctions that result in sales to one of the bidders as .78.[34] We assume that there is a sale when an acquirer finds a suitable target.[35]

[32] The Institute for Shareholder Services publishes data about defensive tactics levels but not the identity of particular firms. Because targets can adopt poison pills very quickly, a searcher will assume that every target has a pill. Larcker, et. al. document significant miscoding in the ISS database with respect to the level of pre-bid defensive tactics associated with particular targets.

[33] Dimopoulos and Sacchetto (2014). Heron and Lie (2015) also find that multiple entrants reduce the likelihood that the initial bidder succeeds.

[34] See Bates, et all (2008).

[35] There are many more agents in the market for corporate control than in our model. Hence, the probability that two actual searching acquirers simultaneously discover the same target is very small. Rather, there are auctions

Because there usually are sales when a firm is put in play, this assumption reduces the difficulty of simulating results without sacrificing much realism. On the other hand, an acquirer expects to match with a target it discovers only with positive probability. Because strong defensive tactics, such as staggered boards, increase a target's ability to find other bidders or otherwise to resist, a searching acquirer that finds a target consummates a sale with a lower probability under strong defensive tactics than under weak defensive tactics. In notation, an acquirer buys a target with probability $\tau^i < 1$, where i ε [w, s] and $\tau^s < \tau^w$. Hence, an acquirer's expected gain from finding a target is $\tau^i \left[\frac{\beta-\alpha}{\beta}\right]$ times the expected match surplus.[36]

Turning to estimated magnitudes, a recent paper studied 5,136 takeover contests between 1998 and 2006 (during which time the legal regime was largely friendly to defensive tactics) and found an average premium above the pre-bid price of 50% (the α) and estimated an average acquirer value above the pre-bid price of .81 (the β).[37] Using the algorithm above, an acquirer's surplus share from completing an acquisition was .333. Our simulations use a surplus split of 1/3 for acquirers and 2/3 for targets in the current defensive tactics regime. We lack valuation data for the defensive tactics-unfriendly regime. Premiums then were around 25 to 30% above the pre-bid price. If bidder valuations were then as they are now, a successful bidder would have received 63% of the surplus under a 30% premium and 69% of the surplus under a 25% premium. Our simulations use a regime-unfriendly defensive tactics split of 2/3 for acquirers and 1/3 for targets. Also, following the reasoning above, we assume $\tau^s = .75$ (under strong defensive tactics the acquirer that finds a target succeeds in acquiring it with probability .75) and $\tau^w = (1.1)\tau^s$.

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when a firm realizes it may be a target, or becomes one, and contacts possible acquirers. We do not discuss auctions but consider them indirectly: defensive tactics increase the ability of a target to run an auction because they permit the target to delay. Before there were statutory or firm created defensive tactics, acquirers would keep bids open for brief periods. Targets thus had little time in which to run auctions. The auction facilitating property of defensive tactics importantly helps to explain why defensive tactics yield surplus splits that favor targets. We note also that with experience the capital market was able to reduce the time in which to generate auctions.

[36] An acquirer's gain from a completed acquisition is higher than this, but it is the expected gain that determines the acquirer's search intensity.

[37] See Dimopoulos and Sacchetto (2014). Because we assume that search can be productive for acquirers, we elide the debate whether acquirers actually profit from acquisitions. Ekmekci and Kos (2016) review the literature and show that when a target has a substantial minority shareholder, which is common, and other plausible conditions obtain, tender offers can be profitable for bidders.

We simulate the model as follows.[38] First, we calculate the expected utility of acquirers (and targets) that search sequentially using our cost parameters, an assumed total value of a match (as a multiple of assumed acquisition costs); and an assumed split. [39] The searchers optimize against the market average surplus split when deciding whether to make an initial search and subsequent searches. For example, under the defensive tactics friendly legal regime, an acquirer's expected utility from finding a target is its split conditional on winning times the probability of winning, or .33 times .75 = 25%, times the match surplus.[40] An agent's expected utility from a search is reported as the average of a thousand simulations for each one of the possible draws.

The number of matches in a market is determined by the number of acquirer searches because all of the acquirers search but a target can only match with an acquirer. It may appear optimal for targets to search more than acquirers search, but this is indicative and inclusive of the targets' wishes that acquirers would search more for them. Target search is important, however, because it complements acquirer search. In our simulations, acquirer expected utility per draw is *increasing* in the amount of target search. This is because the more that targets search the greater is the probability that an acquirer – who may be found by a searching target – makes a match.[41]

Turning to market efficiency, we calculate the probability that a particular target will match given the number of searches acquirers who want to buy targets of that type will make. For example, if acquirers would optimally make three searches for possibly mismanaged targets, we solve for the probability that an acquirer will buy such a target when its search intensity is three. These probabilities are the sigmas for that target type. We then multiply the total number of mismanaged targets in the market by this probability to get the number of

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[38] The Appendix sets out in greater detail how the model unfolds.

[39] We report expected utility as whole numbers and fractions: e.g. 2.35.

[40] The method of payment in an acquisition can affect the price and thus the split. For example, externally financed cash bids are higher than internally financed cash bids. See Vladimirov (2015), which also summarizes earlier studies on the relation of financing bids to bid size. Because we focus on defensive tactics, we assume that all bids are financed in the same way.

[41] Requiring targets to trade at their pre-bid prices would maximize acquirer search but likely would be suboptimal because target search complements acquirer search. Targets would not search if they could not realize gains.

mismanaged target matches. We repeat this exercise for synergy targets. The sum of the mismanaged and synergy matches together is the total number of matches. Dividing the number of made matches by 54 (the number of ex ante efficient matches that could be made) yields the market sigma, the measure of market efficiency. Our tables often specify a whole number plus a fraction: i.e., there are 10.3 matches. Because we do thousands of simulations, we interpret such a result as holding that 10 matches will be made under the parameters and there is a 30% chance of making an 11th.[42]

### 2.2 Results

We begin with a base case as a benchmark: in it, all the acquirers are the same and all the targets are the same. Our results are in Table 1.[43] To interpret this Table, realize that every target is assumed to be a good match for every acquirer so wasted searches occur only when an acquirer hits a noise firm. Acquirers search – analyze firms -- until they find a desirable target or until the next search would yield negative utility.

**Table One**

[42] It is not customary to include information intermediaries in search models, but investment banks are thought to play a helpful intermediary role in the market for corporate control. To see why we do not consider investment banks, consider "conjunctive search" for goods: the searcher screens potential products using one or two "cutoff attribute levels" such as product safety. The searcher than makes full attribute comparisons over the products that survive the screen. In the market for corporate control, the bankers sometimes perform the first of these functions: identifying a subset of firms in which an acquirer is likely to be interested. The acquirer then makes a full investigation of a fraction, or all, of the potential targets in the subset. Define the cost of creating the screened subset $c_s$ and the cost of making a full comparison $c_f$, so $c = c_s + c_f$. Impressionistic evidence suggests that $c_s/c$ is small: the majority of an acquirer's cost is making a full investigation. We know that some acquirers use investment bankers while others do not, but the relative fraction of banker users is unknown. For these reasons, we let $c_s = 0$. Relaxing this assumption would reduce acquirer search costs because an acquirer would only hire a banker whose fee is less than $c_s$. If bankers actually are materially effective, there would be more acquirer search and the market would be more match efficient than our simulations suggest.

[43] In Table One, an A agent is an acquirer, a TP agent is a passive target and a TA agent is a searching target.

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**Base Case**
**Larger Set of Agents with 2% Costs (200 Agents -- 134 A's, 12 P's, 54 T's)**
**2% Costs**

**A and T Split Surplus Asymmetrically**
**(.25 A, .75 T)**
**54 T's (24 TA's, 30 TP's)**
**134 A's**
**12 P's**

| **Sample Size** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|---|---|---|---|---|---|---|---|---|---|---|
| Prob TP (30) | 0.4737 | 0.6901 | 0.7997 | 0.8707 | 0.9121 | 0.9351 | 0.9506 | 0.9615 | 0.9683 | 0.97 |
| Prob TA (24) | 0.775 | 0.9316 | 0.9708 | 0.9852 | 0.992 | 0.9942 | 0.9968 | 0.9982 | 0.9976 | 0.9979 |
| Prob TM (0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sigma | 0.6076111 | 0.7974333 | 0.8757444 | 0.9215889 | 0.9476111 | 0.9613667 | 0.9711333 | 0.9778111 | 0.9813222 | 0.9824 |
| Sigma TP | 0.4737 | 0.6901 | 0.7997 | 0.8707 | 0.9121 | 0.9351 | 0.9506 | 0.9615 | 0.9683 | 0.97 |
| Sigma TA & TM | 0.775 | 0.9316 | 0.9708 | 0.9852 | 0.992 | 0.9942 | 0.9968 | 0.9982 | 0.9976 | 0.9979 |
| Sigma TA | 0.775 | 0.9316 | 0.9708 | 0.9852 | 0.992 | 0.9942 | 0.9968 | 0.9982 | 0.9976 | 0.9979 |
| Sigma TM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sigma A | 0.2448 | 0.3214 | 0.3529 | 0.3714 | 0.3819 | 0.3874 | 0.3913 | 0.394 | 0.3954 | 0.3959 |
| Sigma AH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Matches Made | 32.811 | 43.0614 | 47.2902 | 49.7658 | 51.171 | 51.9138 | 52.4412 | 52.8018 | 52.9914 | 53.0496 |
| Total A Payoff | 565.1 | 598.3 | 477.8 | 299.7 | 74 | -197.9 | -509.5 | -863.9 | -1266.1 | -1731.8 |
| Total AH Payoff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total TP Payoff | 1065.7 | 1552.7 | 1799.3 | 1959.1 | 2052.2 | 2104 | 2138.8 | 2163.3 | 2178.6 | 2182.5 |
| Total TA Payoff | 1359.3 | 1635.4 | 1704.7 | 1730.9 | 1743.1 | 1745.4 | 1748.7 | 1750.4 | 1744.8 | 1742.9 |
| Total TM Payoff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Payoff (Welfare) | 2990.1 | 3786.4 | 3981.8 | 3989.7 | 3869.3 | 3651.5 | 3378 | 3049.8 | 2657.3 | 2193.6 |
| Payoff per Match Made | 91.1310231 | 87.9302577 | 84.1992633 | 80.169514 | 75.6150945 | 70.3377522 | 64.4150019 | 57.7593946 | 50.1458727 | 41.3499819 |
| A Agent Expected Utility | 4.2174 | 4.4652 | 3.5656 | 2.2363 | 0.5519 | -1.4771 | -3.802 | -6.4469 | -9.4486 | -12.9239 |
| AH Agent Expected Utility | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TP Agent Expected Utility | 35.525 | 51.7575 | 59.9775 | 65.3025 | 68.405 | 70.135 | 71.295 | 72.11 | 72.62 | 72.75 |
| TA Agent Expected Utility | 56.6387 | 68.1406 | 71.0303 | 72.121 | 72.63 | 72.7245 | 72.8617 | 72.9334 | 72.7008 | 72.6196 |
| TM Agent Expected Utility | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Expected Welfare | 55.3722222 | 70.1185185 | 73.737037 | 73.8833333 | 71.6537037 | 67.6203704 | 62.5555556 | 56.4777778 | 49.2092593 | 40.6222222 |

**A and T Split Surplus Asymmetrically**
**(.55 A, .45 T)**
**54 T's (12 TA's, 42 TP's)**
**134 A's**
**12 P's**

| **Sample Size** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|---|---|---|---|---|---|---|---|---|---|---|
| Prob TP (42) | 0.482 | 0.6992 | 0.8107 | 0.8732 | 0.9113 | 0.9333 | 0.9489 | 0.9603 | 0.9654 | 0.9706 |
| Prob TA (12) | 0.789 | 0.9363 | 0.9773 | 0.9871 | 0.9925 | 0.9947 | 0.9972 | 0.9975 | 0.9976 | 0.9978 |
| Prob TM (0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sigma | 0.5502222 | 0.7518889 | 0.8477222 | 0.8985111 | 0.9293444 | 0.9469444 | 0.9596333 | 0.9685667 | 0.9725556 | 0.9766444 |
| Sigma TP | 0.482 | 0.6992 | 0.8107 | 0.8732 | 0.9113 | 0.9333 | 0.9489 | 0.9603 | 0.9654 | 0.9706 |
| Sigma TA & TM | 0.789 | 0.9363 | 0.9773 | 0.9871 | 0.9925 | 0.9947 | 0.9972 | 0.9975 | 0.9976 | 0.9978 |
| Sigma TA | 0.789 | 0.9363 | 0.9773 | 0.9871 | 0.9925 | 0.9947 | 0.9972 | 0.9975 | 0.9976 | 0.9978 |
| Sigma TM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sigma A | 0.2217 | 0.303 | 0.3416 | 0.3621 | 0.3745 | 0.3816 | 0.3867 | 0.3903 | 0.3919 | 0.3936 |
| Sigma AH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Matches Made | 29.712 | 40.602 | 45.777 | 48.5196 | 50.1846 | 51.135 | 51.8202 | 52.3026 | 52.518 | 52.7388 |
| Total A Payoff | 1372.5 | 1743.4 | 1799.8 | 1709.1 | 1537.6 | 1297.9 | 1010.7 | 674.3 | 269.7 | -179.8 |
| Total AH Payoff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total TP Payoff | 910.9 | 1321.4 | 1532.2 | 1650.3 | 1722.4 | 1764 | 1793.4 | 1815 | 1824.6 | 1834.5 |
| Total TA Payoff | 408.566 | 485.1698 | 507.5848 | 512.2173 | 514.9276 | 515.1643 | 516.2542 | 515.598 | 513.6518 | 511.627 |
| Total TM Payoff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Payoff (Welfare) | 2691.966 | 3549.9698 | 3839.5848 | 3871.6173 | 3774.9276 | 3577.0643 | 3320.3542 | 3004.898 | 2607.9518 | 2166.327 |
| Payoff per Match Made | 90.601979 | 87.4333727 | 83.8758503 | 79.7949138 | 75.2208367 | 69.9533451 | 64.0745153 | 57.4521725 | 49.6582467 | 41.0765319 |
| A Agent Expected Utility | 10.2428 | 13.0102 | 13.4314 | 12.7547 | 11.4746 | 9.6859 | 7.5425 | 5.0318 | 2.0128 | -1.3421 |
| AH Agent Expected Utility | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TP Agent Expected Utility | 21.6879 | 31.4625 | 36.4821 | 39.2936 | 41.0089 | 42 | 42.6996 | 43.215 | 43.4432 | 43.6779 |
| TA Agent Expected Utility | 34.0472 | 40.4308 | 42.2987 | 42.6848 | 42.9106 | 42.9304 | 43.0212 | 42.9665 | 42.8043 | 42.6356 |
| TM Agent Expected Utility | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Expected Welfare | 49.8512222 | 65.7401815 | 71.1034222 | 71.6966167 | 69.9060667 | 66.2419315 | 61.4880407 | 55.6462593 | 48.2954037 | 40.1171667 |

When the defensive tactics-friendly legal regime governs -- the surplus split favors targets -- acquirers make five searches and there are 51.171 matches, yielding a sigma of .947: the market makes almost 95% of the matches that could be made. In the defensive tactics-unfriendly legal regime, where the split favors acquirers, the acquirers search nine firms and there are 52.518 matches, yielding a σ of .981. In this regime, the market makes over 98% of the possible matches. The defensive tactics-friendly regime thus produces a match inefficiency of about 3.5% – the fraction of matches that could have been made but were not. [44]

[44] We assume that fewer targets search in the pre-defensive tactics world because the surplus split is less favorable to targets. Because target search compliments acquirer search, the drop in target search reduces market efficiency. But because many more acquirers search than targets, the more pro-acquirer split in the absence of defensive tactics overcomes this inefficiency.

The base case is unrealistic, however, because it assumes that all acquirers are alike and all targets are alike. A more realistic assumption is that there are two types of acquirers: financial buyers and strategic buyers. A financial buyer, often a hedge fund or several of them, seeks to purchase a mismanaged target, improve the target's performance and then sell the target. A strategic buyer seeks a synergy match that improves the performance of both parties to the transaction.[45] Thus, there are three types of targets: mismanaged firms, which do not search, passive potential synergy targets and active potential synergy targets that themselves search for a partner.

The more realistic version of the corporate control market should differ from the base case in two ways. First, the market should be match inefficient relative to the base case market because agent heterogeneity dilutes the effectiveness of search.[46] A searching financial buyer now can waste search costs in two ways: when it finds a noise firm or when it finds a synergy target. The financial buyer cannot combine with either target type. A strategic buyer can waste search costs similarly because it cannot combine with a noise firm or a mismanaged target. This buyer lacks the skills to improve stand-alone target performance. Also, active potential synergy targets will pass over financial acquirers because synergy is not possible. Second, defensive tactics should widen the match inefficiency between the two legal regimes. This is because the combination of convex costs and linear returns makes search intensity quite sensitive to the surplus splits. Hence, acquirers should truncate search substantially when the probability that a searched firm is a good target falls from 82% in the base case to much below 82% because search now may uncover the wrong target type, *and* the acquirer's expected return from a match falls from 55% to 25% of the match surplus. Our results for this more realistic case, with the two possible splits, are set out in Table 2.[47]

[45] See Gorbenko and Malenko (2014).

[46] Schwartz and Wilde (1982) first show that search becomes less effective as market agents become more heterogeneous.

[47] In Table Two, an AH agent is a financial buyer who is searching for mismanaged firms; an AS agent is a strategic buyer who is searching for a synergy match; a TM agent is a passive synergy target; a TA agent is a searching synergy target; and a TP agent is a passive mismanaged target.

Table 2

**Larger Set of Agents with 2% Costs (200 Agents -- 134 A's (70 AH's; 64 AS's), 12 P's, 54 T's (12 TA's; 30 TP's; 12 TM's)**
**2% Costs**

**AS and TA Split Surplus Asymmetrically**
**AH and TP Split Surplus Asymmetrically**
**(.25 A, .75 T)**
**AS and TM Split Surplus Asymmetrically**
**64 AS's and 70 AH's**
**54 T's**
**30 TP's, 12 TA's, and 12 TM's**
**12 P's**

| Sample Size | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prob TP (30) | 0.2988 | 0.481 | 0.6094 | 0.6937 | 0.7518 | 0.8019 | 0.8394 | 0.8602 | 0.8829 | 0.9033 |
| Prob TA (12) | 0.4888 | 0.7151 | 0.8341 | 0.9017 | 0.933 | 0.9548 | 0.9732 | 0.9813 | 0.9866 | 0.9898 |
| Prob TM (12) | 0.2742 | 0.4449 | 0.5723 | 0.6628 | 0.728 | 0.7802 | 0.8293 | 0.8506 | 0.8742 | 0.8942 |
| Sigma | 0.3355556 | 0.525 | 0.6510889 | 0.7330556 | 0.7867778 | 0.8310556 | 0.8668889 | 0.8849778 | 0.9040111 | 0.9205 |
| Sigma TP | 0.2988 | 0.481 | 0.6094 | 0.6937 | 0.7518 | 0.8019 | 0.8394 | 0.8602 | 0.8829 | 0.9033 |
| Sigma TA & TM | 0.3815 | 0.58 | 0.7032 | 0.78225 | 0.8305 | 0.8675 | 0.90125 | 0.91595 | 0.9304 | 0.942 |
| Sigma TA | 0.4888 | 0.7151 | 0.8341 | 0.9017 | 0.933 | 0.9548 | 0.9732 | 0.9813 | 0.9866 | 0.9898 |
| Sigma TM | 0.2742 | 0.4449 | 0.5723 | 0.6628 | 0.728 | 0.7802 | 0.8293 | 0.8506 | 0.8742 | 0.8942 |
| Sigma AS | 0.1431 | 0.2175 | 0.2637 | 0.2933 | 0.3114 | 0.3253 | 0.338 | 0.3435 | 0.3489 | 0.3533 |
| Sigma AH | 0.128 | 0.2061 | 0.2612 | 0.2973 | 0.3222 | 0.3437 | 0.3598 | 0.3687 | 0.3784 | 0.3871 |
| Sigma A | 0.1352119 | 0.2115448 | 0.262394 | 0.2953896 | 0.3170418 | 0.3349119 | 0.3493881 | 0.3566642 | 0.3643104 | 0.3709567 |
| A Matches Made | 18.1184 | 28.347 | 35.1608 | 39.5822 | 42.4836 | 44.8782 | 46.818 | 47.793 | 48.8176 | 49.7082 |
| Total Matches Made | 18.12 | 28.35 | 35.1588 | 39.585 | 42.486 | 44.877 | 46.812 | 47.7888 | 48.8166 | 49.707 |
| Total AS Payoff | 104.341 | 108.8802 | 68.3062 | -5.3885 | -109.244 | -232.1744 | -375.0844 | -552.3174 | -750.6658 | -977.2323 |
| Total AH Payoff | 84.075 | 92.1648 | 61.4132 | -7.3702 | -107.5068 | -226.3217 | -372.5781 | -553.1779 | -757.4644 | -984.6081 |
| Total TP Payoff | 672.2 | 1082.2 | 1371.1 | 1560.9 | 1691.6 | 1804.2 | 1888.7 | 1935.5 | 1986.6 | 2032.5 |
| Total TA Payoff | 419.278 | 611.9578 | 712.4841 | 769.8996 | 794.0712 | 811.5724 | 825.8334 | 830.2041 | 832.6026 | 831.4566 |
| Total TM Payoff | 246.825 | 400.425 | 515.025 | 596.475 | 655.2 | 702.225 | 746.325 | 765.525 | 786.75 | 804.825 |
| Total T Payoff | 1338.303 | 2094.5828 | 2598.6091 | 2927.2746 | 3140.8712 | 3317.9974 | 3460.8584 | 3531.2291 | 3605.9526 | 3668.7816 |
| Total Payoff (Welfare) | 1526.719 | 2295.6278 | 2728.3285 | 2914.5159 | 2924.1204 | 2859.5013 | 2713.1959 | 2425.7338 | 2097.8224 | 1706.9412 |
| Payoff per Match Made | 84.2560155 | 80.9745256 | 77.6001598 | 73.6267753 | 68.8255049 | 63.7186376 | 57.95941 | 50.7594625 | 42.9735459 | 34.3400567 |
| A Agent Expected Utility | 1.40608955 | 1.50033582 | 0.96805522 | -0.0952142 | -1.6175433 | -3.4216127 | -5.5795709 | -8.2499649 | -11.254703 | -14.6406 |
| AS Agent Expected Utility | 1.6303 | 1.7013 | 1.0673 | -0.0842 | -1.7069 | -3.6277 | -5.8607 | -8.63 | -11.7292 | -15.2693 |
| AH Agent Expected Utility | 1.2011 | 1.3166 | 0.8773 | -0.1053 | -1.5358 | -3.2332 | -5.3225 | -7.9025 | -10.8209 | -14.0658 |
| TP Agent Expected Utility | 22.4075 | 36.075 | 45.7025 | 52.03 | 56.3875 | 60.14 | 62.9575 | 64.515 | 66.22 | 67.75 |
| TA Agent Expected Utility | 34.9398 | 50.9965 | 59.3737 | 64.1583 | 66.1726 | 67.631 | 68.8194 | 69.1837 | 69.3836 | 69.2881 |
| TM Agent Expected Utility | 20.5687 | 33.3687 | 42.9187 | 49.7063 | 54.6 | 58.5188 | 62.1938 | 63.7937 | 65.5625 | 67.0688 |
| Expected Welfare | 28.2725741 | 42.5116259 | 50.5246019 | 53.9725167 | 54.1503778 | 52.9537278 | 50.2443685 | 44.9209963 | 38.848563 | 31.6100222 |

**AS and TA Split Surplus Asymmetrically**
**AH and TP Split Surplus Asymmetrically**
**(.55 A, .45 T)**
**AS and TM Split Surplus Asymmetrically**
**64 AS's and 70 AH's**
**54 T's**
**30 TP's, 12 TA's, and 12 TM's**
**12 P's**

| Sample Size | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prob TP (30) | 0.2996 | 0.4821 | 0.609 | 0.6955 | 0.7567 | 0.8046 | 0.8377 | 0.8648 | 0.8799 | 0.8995 |
| Prob TA (12) | 0.4886 | 0.7155 | 0.8286 | 0.8973 | 0.9377 | 0.9566 | 0.9706 | 0.9796 | 0.9869 | 0.9899 |
| Prob TM (12) | 0.2689 | 0.448 | 0.567 | 0.6657 | 0.7326 | 0.776 | 0.8254 | 0.8517 | 0.8742 | 0.8945 |
| Sigma | 0.3347778 | 0.5263889 | 0.6484667 | 0.7337222 | 0.7915667 | 0.8320222 | 0.8645 | 0.8874 | 0.9024111 | 0.9184778 |
| Sigma TP | 0.2996 | 0.4821 | 0.609 | 0.6955 | 0.7567 | 0.8046 | 0.8377 | 0.8648 | 0.8799 | 0.8995 |
| Sigma TA & TM | 0.37875 | 0.58175 | 0.6978 | 0.7815 | 0.83515 | 0.8663 | 0.898 | 0.91565 | 0.93055 | 0.9422 |
| Sigma TA | 0.4886 | 0.7155 | 0.8286 | 0.8973 | 0.9377 | 0.9566 | 0.9706 | 0.9796 | 0.9869 | 0.9899 |
| Sigma TM | 0.2689 | 0.448 | 0.567 | 0.6657 | 0.7326 | 0.776 | 0.8254 | 0.8517 | 0.8742 | 0.8945 |
| Sigma AS | 0.142 | 0.2182 | 0.2617 | 0.2931 | 0.3132 | 0.3249 | 0.3367 | 0.3434 | 0.349 | 0.3533 |
| Sigma AH | 0.1284 | 0.2066 | 0.261 | 0.2981 | 0.3243 | 0.3448 | 0.359 | 0.3706 | 0.3771 | 0.3855 |
| Sigma A | 0.1348955 | 0.2121403 | 0.2613343 | 0.2957119 | 0.3189985 | 0.3352955 | 0.3483493 | 0.357609 | 0.3636791 | 0.3701209 |
| A Matches Made | 18.076 | 28.4268 | 35.0188 | 39.6254 | 42.7458 | 44.9296 | 46.6788 | 47.9196 | 48.733 | 49.5962 |
| Total Matches Made | 18.078 | 28.425 | 35.0172 | 39.621 | 42.7446 | 44.9292 | 46.683 | 47.9196 | 48.7302 | 49.5978 |
| Total AS Payoff | 375.302 | 528.7496 | 566.861 | 556.7073 | 495.6712 | 389.9305 | 268.3006 | 108.5933 | -82.1084 | -298.2459 |
| Total AH Payoff | 354.395 | 526.8777 | 608.8753 | 619.8609 | 578.6808 | 500.5582 | 380.6029 | 230.6198 | 34.7336 | -181.4194 |
| Total TP Payoff | 404.5 | 650.8 | 822.1 | 939 | 1021.5 | 1086.2 | 1130.9 | 1167.5 | 1187.8 | 1214.3 |
| Total TA Payoff | 243.233 | 354.8888 | 409.3336 | 442.4738 | 461.3588 | 468.6737 | 473.2552 | 475.9831 | 477.915 | 476.2141 |
| Total TM Payoff | 145.215 | 241.92 | 306.18 | 359.46 | 395.595 | 419.04 | 445.725 | 459.9 | 472.095 | 483.03 |
| Total T Payoff | 792.948 | 1247.6088 | 1537.6136 | 1740.9338 | 1878.4538 | 1973.9137 | 2049.8802 | 2103.3831 | 2137.81 | 2173.5441 |
| Total Payoff (Welfare) | 1522.645 | 2303.2361 | 2713.3499 | 2917.502 | 2952.8058 | 2864.4024 | 2698.7837 | 2442.5962 | 2090.4352 | 1693.8788 |
| Payoff per Match Made | 84.2264078 | 81.0285347 | 77.4862039 | 73.6352439 | 69.0802066 | 63.7536925 | 57.8108455 | 50.9728003 | 42.8981453 | 34.1522971 |
| A Agent Expected Utility | 5.4455 | 7.87781567 | 8.77415149 | 8.7803597 | 8.01755224 | 6.64543806 | 4.84256343 | 2.53144104 | -0.3535433 | -3.5795918 |
| AS Agent Expected Utility | 5.8641 | 8.2617 | 8.8572 | 8.6986 | 7.7449 | 6.0927 | 4.1922 | 1.6968 | -1.2829 | -4.6601 |
| AH Agent Expected Utility | 5.0628 | 7.5268 | 8.6982 | 8.8552 | 8.2669 | 7.1508 | 5.4372 | 3.2946 | 0.4962 | -2.5917 |
| TP Agent Expected Utility | 13.4835 | 21.6945 | 27.4035 | 31.299 | 34.0515 | 36.2055 | 37.698 | 38.916 | 39.594 | 40.4775 |
| TA Agent Expected Utility | 20.2694 | 29.5741 | 34.1111 | 36.8728 | 38.4466 | 39.0561 | 39.4379 | 39.6653 | 39.8263 | 39.6845 |
| TM Agent Expected Utility | 12.1013 | 20.16 | 25.515 | 29.955 | 32.9663 | 34.92 | 37.1438 | 38.325 | 39.3413 | 40.2525 |
| Expected Welfare | 28.1971296 | 42.6525204 | 50.2472204 | 54.0278148 | 54.6815889 | 53.0444889 | 49.9774759 | 45.233263 | 38.711763 | 31.3681259 |

In the legal regime that is unfriendly to defensive tactics, the financial buyers make nine searches, the strategic buyers make eight searches and there are 48.82 matches -- a sigma of .93. In the regime that is friendly to defensive tactics, both the financial buyers and the strategic buyers make three searches. The number of matches falls to 39.585, yielding a sigma of .651. The market now makes 65% of the possible matches, so match efficiency falls by 28%. This dramatic drop in market efficiency occurs because acquirers reduce their search intensity by more than half when defensive tactics go strongly against them. Regarding what we expected, there are fewer matches under both legal regimes in the more realistic case than in the base case and the efficiency gap between the two legal regimes widens significantly. [48]

To summarize, practitioners and some academics argue that defensive tactics deter an immaterial number of bids because there are so many acquisitions each year. To the contrary, our simulations suggest that the corporate control market is significantly less match efficient under the defensive tactics-friendly legal regime than under the defensive tactics-unfriendly regime. Because there are more acquirers than searching targets, the total number of market searches, and thus the total number of matches made, falls when the legal regime shifts surplus toward targets and *away from* acquirers. There are over a trillion dollars of acquisitions made in the corporate control market each year. Under a defensive-tactics-unfriendly legal regime, our simulations show, the market could make 28% more positive expected value acquisitions in each of these years. Thus, to the extent that our simulations resemble the real world, defensive tactics cause a large reduction in social welfare.[49]

The large reduction in social welfare our simulations yield probably is overstated, however. Initially, not every acquisition works out. The welfare loss from mistaken matches should be subtracted from the welfare loss from lost matches. Further, our matlab program counts an acquirer's visit to a firm that has already been matched as a wasted search.[50] This may be unrealistic because matched firms probably look different from unmatched firms. Hence, actual acquirers may not search matched firms intensely. Because the program overstates wasted searches, it also understates market efficiency. Finally, as with most search models, we assume that an acquirer has to search a firm in order to see if it is a good match: in effect, we ignore advertising. There is an active financial press, however, so acquirers may have

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[48] We view these results as a robustness check for the simulation method. Because agents are more heterogeneous in the realistic market than in the base case market, the realistic market should be less match efficient than the base case market and the relative inefficiency between the defensive tactics friendly regime and the unfriendly regime should widen. Our simulations yield these results.

[49] Using the figure quoted earlier of a $1.04 trillion annual acquisition market, approximately $280 billion more in acquisitions would be made annually under the pre-defensive tactics regime. By way of contrast, a recent paper estimated the efficiency loss from the lock in effect that capital gains taxes exert on M&A activity. The authors estimate an efficiency loss of $3.06 billion per year for the United States. See Feld, et al (2016).

[50] Because we define a match as a completed deal, we do not permit an acquirer to make a competing bid when its search uncovers a matched firm.

a better chance of narrowing search to productive areas than our model permits.[51] Nevertheless, the simulation parameters are plausible, the qualitative results accord with intuition and the defensive tactics inefficiency is very large. If the three qualifications just noted reduce the simulated inefficiency by half, the market still makes 14% fewer matches under the strong defensive tactics regime than under the weak defensive tactics regime. This is a major welfare loss given the size of the market. Thus, the welfare effects of defensive tactics should be moved up on the scholarly and regulatory agenda.

## 3. Shareholder Welfare

### *3.1* **The Target's Cho*ice* of Defensive Tactics**

Defensive tactics are authorized by the board of directors in response to management recommendations.[52] In turn, courts set the level of allowable defensive tactics in the course of resolving litigation brought by shareholders challenging the board's deployment of defensive tactics. The plaintiff shareholders' typical complaint is either that the target was sold for too little or that, in consequence of defensive tactics, the target was not sold at all. A board's core fiduciary duty is to maximize value for target shareholders.[53] The question for courts, then, is what level of defensive tactics satisfies this obligation: When the claim is that the target was sold for too little, should the board have resisted more strenuously? When the claim is that an offer was prevented, should the board have resisted less strenuously?

How much resistance is beneficial to the shareholders is difficult to answer rigorously because, up to now, there has been no convenient way to assess with precision the

[51] On the other hand, we bias results in favor of defensive tactics because the ratio of targets to acquirers in our simulations is relatively high and the ratio of noise firms to acquirers is relatively low. Given the sensitivity of search intensity to the surplus split, reducing the former ratio and increasing the latter would materially reduce match efficiency.

[52] Some defensive tactics, like poison pills, can be authorized and deployed by the board alone. Others, like barriers to a post-acquisition freeze-out of target shareholders require a charter amendment and therefore shareholder approval after board initiation. Defensive tactics that require shareholder approval are ineffective: the ultimate defensive tactic is for shareholders to reject hostile bids.

[53] The board's duty is usually stated as owed to the corporation and its shareholders. Because it is difficult to describe the circumstances in which the long-term value to the shareholders of an action and the value of that action to the corporation diverge, we use the shareholder-only framing of fiduciary duty to avoid the additional phrase.

effectiveness of different tactics and so their welfare effects. For example, it is difficult to know whether a supermajority voting requirement is better or worse for target shareholders than a poison pill. In each case, the particular context matters – for example, a two-third's vote requirement to take an action desired by the shareholders to facilitate a bid going forward may be ineffective if the shares are widely held, but very effective if management and the board together own 34 percent of the target's stock. The Delaware courts – the courts that define takeover law in the U.S. – have come to give target boards great leeway in setting the level of defensive tactics; as said above, a defensive tactic is permissible unless it almost precludes an acquisition, whether directly or through an initial proxy contest to replace the target board. [54] Thus, current judicial takeover law poses two problems. First, it does not address the social welfare question. Second, it does not address the shareholder welfare question rigorously. We initially take up the second question in this section, and then relate the results to the social welfare question.

Part 2 suggests that a loyal board's task is to choose the level of defensive tactics that maximizes the target shareholders' portion of the surplus an acquisition can create. Defensive tactics increase the target board's bargaining power with a potential acquirer largely because they permit the target to delay. The more patient party to a negotiation is advantaged because it can wait longer for better offers. Acquirers are less patient than targets, especially targets that are reluctant to sell. Therefore, the better are defensive tactics at permitting target boards to refuse offers and wait, the more power targets have relative to acquirers. As examples of how delay reduces acquirer patience, a financial acquirer cannot continue negotiating because alternative investments may disappear with time and resources are tied up in the proposed deal. Delay also can reduce target value, and may deter bids, if there is a limited window in which a "fix" of the target would be most effective. As an illustration, if it is the target's business strategy that needs fixing, the longer the expected delay between the bid and a deal the more value the target can lose. Sufficiently large expected value declines could preclude

[54] And in some circumstances as a practical matter the tactics do preclude an offer. For example, a court allowed a package of defensive tactics that would require a bidder to win two proxy contests over two years to prevail even though the record reflects that no bidder had ever continued its offer for two successive proxy fights. See Air Gas supra note 4.

offers altogether. Further, the likelihood of additional bidder entry increases with time. Auction prices increase in the number of bidders so the possibility of entry reduces acquirer expected gains.[55] Entry also poses a differential threat to a financial acquirer because a target has less private value to it than it has to a synergy acquirer. To summarize, the common metric along which to assess the efficacy of defensive tactics is time. The longer is the period during which an acquirer must keep an offer open or cannot make a formal offer, the more patient the target board can be and the larger the share of the expected acquisition surplus the target can extract.

Turning to bid probabilities, targets choose defensive tactics levels before acquirers begin to search. Hence, acquirers optimize against the market average, which an individual target cannot affect. Nevertheless, potential targets have an incentive to take bid probabilities into account. Initially, a firm can choose a defensive tactics level sufficiently high as to preclude bids altogether; that is, it can be a noise firm. In addition, an acquirer searching sequentially that finds a target with above average defenses may go on to search another firm. For these reasons, a loyal target board, when choosing its defensive tactics level, should consider the reduction in the probability of a bid as well as the increase in the bid share going to the target.[56] The board's problem, then, is to solve for the optimal level of defensive tactics: the level that efficiently trades off the probability of receiving a bid – weak defenses -- against the price conditional on a bid being made -- strong defenses.

The target board's problem thus is to

$$\text{Max}_d\ E(R) = \pi(\lambda s) - c(d)$$

[55] Heron and Lie (2015) find that "poison pills induce greater final takeover premiums, mostly as a result of bid increases after the initial bid." (at 287).

[56] Karpoff, et. al (2015) at 4-5 summarize: "…we find that takeover likelihood is negatively and significantly related to both the G-Index and the E-Index." Lower scores on these indices correlate with higher defensive tactics levels. Similarly, "the evidence suggests that managerial self-interest causes the overall frequency of takeovers to be lower than optimal for target shareholders." Jenter and Llewellyn (2015) at 2815. Cunat, et al, (2015) show that a shareholder vote to remove a takeover defense increases the probability the firm will receive a bid. The strong defense entailed by combining a poison pill with a staggered board materially reduces the probability that a particular firm is acquired. E.g., Giang (2015); Sokolyk (2011); Bates, et al (2008). Finally, reducing supermajority voting requirements increases tender offers for Delaware targets. Boone, et al (2015).

where R is bid revenue, π is the bid probability, λ is the target's expected share of the acquisition surplus[57], which is s, and d is the target's defensive tactics level.[58] The bid probability π is a decreasing function of the target's surplus share. The surplus share λ is an increasing function of the defensive tactic level d: λ = f(d). We assume that $c(d) = \frac{cd^2}{2}$, which is standard, and that $\pi(\lambda) = \frac{-\lambda d^2}{2}$. This assumption may require explanation. Because the acquirer's search costs are convex – its costs increase at a greater rate as its search becomes more intense – the acquirer is more sensitive to higher target share prices, which wipe out more of the gains from search, than to lower target prices. Hence, we assume that the bid probability π is convex in d.

The first order condition is

$$E'(R) = s\left[\frac{d\pi}{d\lambda}\frac{d\lambda}{dd}\right] - cd < 0$$

There is no closed form solution to this condition without an expression for λ as a function of d, the level of defensive tactics. We know that λ is non-decreasing in d, however, and we argue that the expression λ = f(d) is quadratic. The acquirer's bargaining power falls as time extends, and should fall rapidly when enough time has run to threaten a loss of financing, the entry of other bidders, or the exposure of confidential information. This reasoning suggests that an acquirer's incentive to make a high bid also increases rapidly as the likelihood of a threat to the bid's success goes up. On these assumptions, the second order condition of the target's revenue function also is negative. To summarize, the first term in E'(R) is negative because $\frac{d\pi}{d\lambda} = -\lambda d$ and the second term is –cd. E''(R) also is negative because $\frac{d^2\pi}{d\lambda} = -d$ and the second term is –c. Because both the first and the second derivatives of the revenue function are negative, the function is strictly concave in d. There is a defensive tactics level that yields each target's surplus maximizing share λ*(d).

[57] Relating the notation here to the analysis in Part 2, the acquirer's realized share of the surplus from an acquisition is $\frac{\beta}{\beta-\alpha}$, which equals 1 – λ in the text above. Similarly, $\lambda = 1 - \frac{\beta}{\beta-\alpha}$.

[58] The cost c(d) of choosing a defensive tactics level includes legal and investment banker fees for advice and the cost, where applicable, of soliciting shareholder approval.

Courts deciding acquisition cases review a target board's conduct to see if the board has complied with its fiduciary duty because the board is conflicted: it has an incentive to choose defensive tactics that minimize the probability of hostile acquisitions in order to protect the board's and management's private benefits of control.[59] A loyal board would enact defensive tactics that would generate for the target company the share $\lambda^*(d)$ of the surplus from a bid: this share efficiently trades off the probability of getting a bid against the bid price if a bid is made. Because $\lambda^*(d) > 0$, the Delaware courts, assessing a board's conduct by its compliance with the duty of loyalty, should permit target boards to adopt some defensive tactics. The issue is whether a target's actual defenses are too great: should those tactics survive the stricter scrutiny applied to defensive tactics than to ordinary business decisions? In practice, as we have seen, the stricter review turns out not to be very strict. Delaware courts say that the level of defensive tactics should be "proportionate to the threat posed" by an acquirer, but collapsing the nested levels of the courts' verbal formulations, the courts approve any tactic that is not "preclusive". In turn, this has allowed a target board to delay a bid for up to two years if the target corporation has a staggered board. This discretion permits target boards to choose defensive tactics levels sufficiently high as to generate suboptimal returns.

Our simulations are suggestive regarding the privately optimal target share. We solved for target expected returns under ten surplus splits: from .1 going to the target to 1. Figure 1 below only reports results for.8, and below, however, because acquirers do not search at higher target shares.

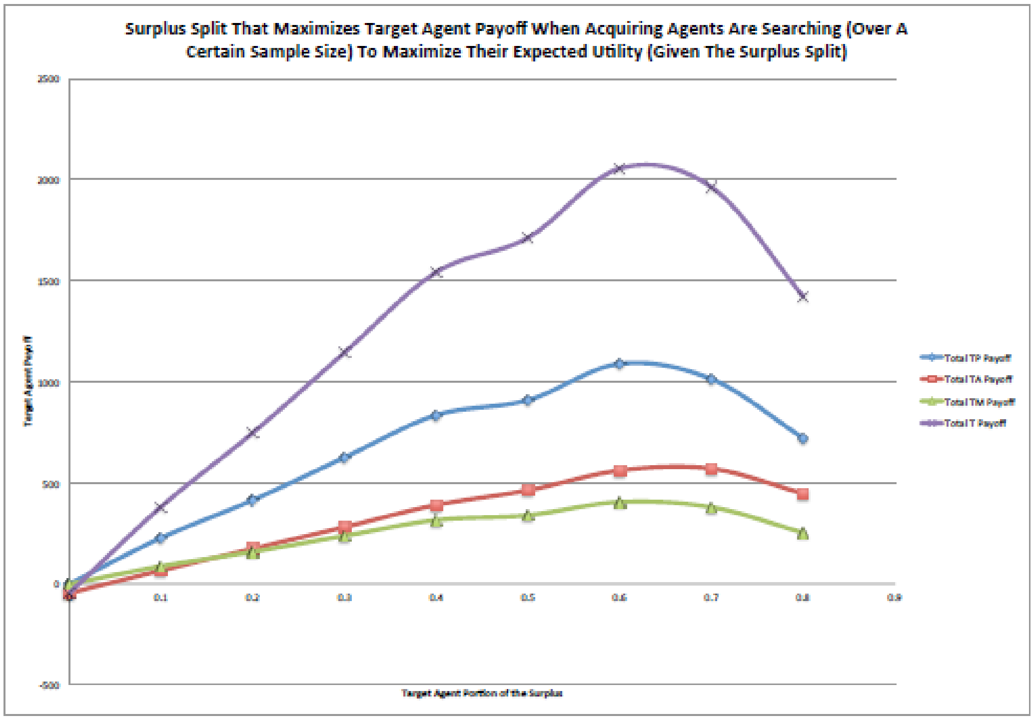
[59] We include here non-pecuniary private benefits of control, for example, avoiding the public humiliation of shareholders preferring a premium to the board's continued stewardship.

## Figure 1

Larger Set of Agents with 2% Costs (200 Agents -- 134 A's (70 AH's; 64 AS's), 12 P's, 54 T's (12 TA's; 30 TP's; 12 TM's)
2% Costs
Sample Search Size at which the Expected Utility of Being an A Agent is a Maximum for each Split of the Surplus

| Surplus Split (% to T Agents) | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
|---|---|---|---|---|---|---|---|---|---|
| Total TP Payoff | 0 | 227.89 | 415.1 | 625.86 | 835.6 | 910.1 | 1089.4 | 1013.9 | 722.2 |
| Total TA Payoff | -45.3018 | 66.5155 | 174.078 | 281.5627 | 390.6841 | 463.1653 | 561.3834 | 570.54 | 447.616 |
| Total TM Payoff | 0 | 87.56 | 159.06 | 238.02 | 316.36 | 340.4 | 405.48 | 379.61 | 253.84 |
| Total T Payoff | -45.3018 | 381.9655 | 748.238 | 1145.4427 | 1542.6441 | 1713.6653 | 2056.2634 | 1964.05 | 1423.656 |

AS and TA Split Surplus Asymmetrically
AH and TP Split Surplus Asymmetrically
AS and TM Split Surplus Asymmetrically
64 AS's and 70 AH's
54 T's
30 TP's, 12 TA's, and 12 TM's
12 P's




The lowest, TM, curve is the return of passive synergy targets who will match with a synergy acquirer; the second, TA, curve is the return of synergy targets who search for acquirers. This return is higher, despite the target's search costs, because of the increase in the probability of matching. The third, TP, curve is the return of passive mismanaged targets who do best because they match with financial acquirers but do not search themselves. The highest, T, curve sums the other three.

Each expected return curve is strictly concave, with a left hand skew. The skew is consistent with the sequential search model above. We assume convex search costs while our simulations increase the surplus shares linearly: that is, we ask how much search there will be when the acquirer's share is .2, then .3 and so on. On our assumptions, an acquirer's return from search should turn negative earlier when its share falls, say, from .4 to .3 than when its share falls from .6 to .5. This phenomenon is reflected in the large drop in the sigmas – the match efficiency parameter – that Table 2 exhibits when the surplus split moves strongly against the acquirers. As a consequence, there should be much less acquirer search when the target's surplus share increases by .1 from its maximizing share than there should be when the target's share increases by .1 to its maximizing share. Because a target's expected return is a function of acquirer search intensity, and because acquirer search intensity is a function of the acquirer share, a target's return should decrease more rapidly as its surplus share goes beyond the maximum than the return should increase as the target's share goes toward the maximum. This reasoning suggests that the target's expected return, as a function of the defensive tactics level it chose, should be strictly concave with a left hand skew; and this is what the simulations show.

### *3.2* **Social Welfare, Shareholder Welfare and the Delaware Courts**

Turning to what these results may mean, in the simulations a target's expected return is maximized at approximately a 62% surplus share. This is close to the two thirds split we let obtain in the defensive-tactics-friendly legal regime analyzed above. The simulations thus suggest that many current boards are complying with their duty of loyalty as regards defensive tactics: these boards, that is, are choosing defensive tactics levels that approximate the levels that would maximize a target's expected acquisition return. From the target shareholders' perspective, the best solution is interior.[60] The corporate governance implication of this result is that target boards should have significant, though not complete, discretion to employ defensive tactics.[61]

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[60] See Table 2. Defensive tactics may insulate target boards from takeovers and also may maximize target shareholder returns. Hence, there is no agency conflict between boards and shareholders up to the maximizing defensive tactics level. Compare Easterbrook & Fischel (1981) and Gilson (1981).

[61] There is a common view that defensive tactics lower firm value. This view has led to several papers, some summarized below, that seek to explain how loyal boards can efficiently choose those tactics. To the contrary, in our simulations defensive tactics raise firm value, over a range, because they (privately) efficiently resolve the tradeoff between the probability of receiving bids for the firm and inducing the bidders to pay high prices. In contrast, a board that seeks to block bids entirely would reduce firm value.

Nonetheless, the question remains whether courts have allowed boards to go too far. The data we use to infer a two-thirds split in favor of targets ended in 2006. Delaware courts now allow the poison pill/staggered board combination to create a delay period of up to two years. Therefore, there is a possibility that some potential targets are choosing defensive tactics levels that yield surplus splits above the mid-sixties target share. This possibility is a cause for concern if target expected returns fall off as sharply in life when targets choose excessive defensive tactics levels as those returns fall off in the simulations.

Finally, the simulations suggest that there is a significant conflict between private and social efficiency. Target shareholder welfare in the simulations is maximized when a target's share of the acquisition surplus – λ in the analysis above – is in the 60 percents. As Part 2 shows, such surplus shares yield a number of matches that is much below the socially optimal level. This large difference between individual and collective welfare reflects the property of defensive tactics to create a negative externality. Because an individual target cannot influence the market level of acquirer search by the target's choice of defensive tactics, a target board ignores the search dampening effect of those choices. Hence, in equilibrium each potential target chooses a defensive tactics level that, when aggregated, yields a market average level that is higher than the collectively rational level. Because potential acquirers choose search intensities with the market average in mind, boards that maximize shareholder welfare are reducing social welfare. Legal reform that would restrict defensive tactics levels, our simulations suggest, thus may be efficient.

A countervailing consideration, called the bonding or short time horizon theory, takes two forms.[62] First, the combination of a claim that the stock market over-discounts future returns and the effect of that myopia on managerial incentives would create welfare losses in an unregulated corporate control market. Stein (1988); Kay (2012) Target directors and managers sometimes make firm specific human capital investments that could create value for

[62] An objection to restricting defensive tactics, reflected in judicial decisions and pro-management commentary, holds that hostile takeovers are unfair to target shareholders because the shareholders, unlike a unified board, cannot coordinate to negotiate for higher prices. This objection is without merit, unless there is a distributional reason to prefer target shareholders to acquirer shareholders, because restricting defensive tactics shifts surplus to the acquirers.

the company. These agents commonly are partly compensated with stock, but stock would be an inadequate reward if the value of those investments is not fully reflected in the target's current price and the target's shareholders accept a hostile offer. Because managers and directors often are dismissed after takeovers, they thus face risk that they may not be rewarded for successful long-term investments. This risk may cause directors and managers to take a short-term view. On this account, defensive tactics represent a commitment from the target's shareholders to their management and board that the company either will not be sold prematurely, or that it will bargain for an appropriate price if it is in play. Hence, if this version of the bonding theory is correct, there is an efficiency tradeoff: defensive tactics inefficiently produce too few matches but efficiently create good investment incentives for corporate directors and managers. [63]

Also, customers or suppliers may make relationship specific investments with a potential target. An acquirer, who has no particular loyalty to these customers and suppliers, may exploit the sunk cost aspect of the investments by renegotiating the target's deals with the customers or suppliers. See Summers and Shleifer; Johnson, et al (2015). Anticipating such behavior, the customers and suppliers may make a weaker commitment to a potential target.

These considerations are more inchoate than incorrect. To say that there is a tradeoff is not to say how it should be resolved. As yet, neither theory nor evidence show which efficiency claim is the stronger: does the impact of myopia exceed that of reduced search? Also, there are theoretical concerns. To see why, assume that the defensive tactics unfriendly regime is in place and a firm's executives are given a golden parachute and a compensation package with a significant variable component. In the event of a successful hostile bid, the executive would receive a large payment from her golden parachute and, if the historical average regarding surplus splits holds, a large payoff from her stock.[64] The open issue is the elasticity of the

[63] Gilson (1982) first suggested that defensive tactics which require shareholder approval, such as staggered boards, may represent an efficient commitment from shareholders to managers and boards not to dismiss these agents prematurely, but tactics that do not require board approval may inefficiently reduce shareholder value. Cremers, et al, (2015) contains data that support this view. The distinction between the two types of defensive tactics is an interesting area for research.

[64] Sepe and Whitehead (2015) show that golden parachutes create incentives for managers to invest in innovation by compensating them if they are dismissed before an innovation comes to fruition. Fich, et al (2013) also show

executive's investment behavior to her expected end game payoff. Would the prospect of the increased payoff on a takeover resulting from a low defensive tactics level offset the executive's incentive to shorten the firm's investment horizon? In addition, the shareholder signal of commitment that is said to accompany adopting defensive tactics prior to a hostile bid is credible only if the shareholders are required to approve their adoption. This is not the case with the adoption of a poison pill, or with respect to the combination of a poison pill and a staggered board, if the firm has a staggered board structure dating to the pre-poison pill era. Finally, the decision whether to approve a pre-bid defensive tactic and to approve a decision to tender at the price offered in a hostile takeover are largely made by institutional investors, who today hold about 70% of public company stock. These investors have the incentive and apparently the ability to recognize the difference between a confiscatory and a compensatory acquirer bid. Finally, we note that the empirical claim that the stock market is myopic, on which this argument is based, is contested.[65]

The short-term theory, as applied to customers or suppliers, also raises theoretical questions. For example, a supplier can protect itself with a long-term contract because such contracts bind acquirers. Some negotiated labor agreements bind acquirers as well. A contract seems more secure than a personal relationship. To be sure, some contracts between companies and their customers and suppliers are implicit when it is too costly to contract over the full action space. Nevertheless, the short-term theory is incomplete. If implicit contracts are sufficiently attractive to existing management to make it in the target's interest to comply voluntarily, both to facilitate deals and to create a good reputation, the implicit contracts should be equally attractive to an acquirer. The converse would follow as well. Proponents of this short-term theory thus need to explain why a strategy that is maximizing for the target when independent is not also maximizing for the target as part of the acquirer. Finally, this version of the bonding theory lacks significant empirical study. Both versions of the short-term theory thus need more work. Nevertheless, our contribution is on the other side of the ledger:

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that golden parachutes materially increase deal completion probabilities, create large gains for target CEOs and may benefit target shareholders.

[65] Roe (2013) surveys the empirical and legal literature concerning short-termism.

we suggest that defensive tactics alone can increase firm value but also can be socially inefficient.

We end this discussion of shareholder welfare with the observation that the evolution of Delaware takeover law that is characterized in our model and simulations reflects a long-standing disagreement between the Delaware Chancery Court (the trial court for corporate cases) and the Delaware Supreme Court, which hears appeals from decisions by the Chancery Court, over what limits on defensive tactics maximizes target shareholder welfare.[66] Interestingly, our model and simulations shed light on this still ongoing dispute. Following the Delaware Supreme Court's original decision to impose a higher standard of review on a board's deployment of defensive tactics, the Chancery Court addressed how this higher standard would be applied. Under the Chancery Court's regime, a target board confronted by a hostile bid could deploy defensive tactics, such as the poison pill, to buy time to seek a higher bid or to explain the target's "real" value to its shareholders. Once the target's board has had that opportunity, however, the shareholders must be allowed to decide whether to accept the offer.[67] As we have seen, the Delaware Supreme Court rejected that time limit on the use of defensive tactics, in favor of a rule that, with the help of a poison pill and a staggered board, allowed the target board formally to delay a bid for as long as two election cycles, a period that in practice no bidder apparently has survived.[68] Thus, the legal debate between the Chancery and Supreme Courts was between an interior and a corner solution.

Our analysis shows that the critical issue in assessing defensive tactics is time: the delay associated with defensive tactics increases target shareholder welfare at the outset but then reduces it as the delay extends past the point where the reduced number of bids resulting from the delay is outweighed by the increased target share of the surplus that an actual bid creates. Seen through the prism of our model and simulations, the Chancery Court thus had the better of the debate. From the target shareholders' perspective, the Chancery Court was correct in giving the board the time to increase the premium received by the target shareholders, but also

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[66] Delaware takeover law has not concerned itself with what rule maximize social welfare.
[67] Capital City Associates v. Interco Inc., 551 A.[2d] 1140 (Del. Ch. 1988).
[68] Airgas, supra note 4.

correct in constraining the length of that delay. The Chancery Court's informal analysis and our model and simulation point generally in the same direction: giving the target board too much discretion to delay a hostile tender offer not only is socially inefficient; it also reduces target shareholder welfare.

## 4. Conclusion

The allocation of power between boards and shareholders concerning takeovers raises two basic questions: what level of defensive tactics maximizes social welfare? And what level of defensive tactics maximizes target shareholder welfare? Debate on these questions has largely focused on the shareholder welfare question for two reasons. First, restrictions on deploying defensive tactics are specified by state courts in the context of litigation brought by shareholders challenging the level deployed in a particular hostile offer. In these courts, the legal question is whether a target board has fulfilled its fiduciary duty to maximize the welfare of the target company's shareholders. The bulk of the legal literature thus asks whether courts answer the fiduciary question correctly. Participants in this debate thus assess governance techniques along the metric of shareholder interests.

The less obvious reason why debate has focused on target shareholder welfare is that the social welfare effects of various defensive tactics are difficult to evaluate without analyzing the market equilibria the tactics produce. The principal economic and policy question an equilibrium analysis should answer is whether defensive tactics reduce the number of acquisitions below the socially optimal level. In turn, this question is hard to answer because the analyst cannot observe the number of acquisitions that would have been made *but were not* under various defensive tactics legal regimes.

This paper takes preliminary steps toward redressing the scholarly balance between the two questions. It addresses the social welfare question by simulating equilibrium outcomes in the market for corporate control under two defensive tactics legal regimes: a regime that restricts defensive tactics and a regime, roughly like the current Delaware rules, that depending on the context of a particular bid can give target boards the ability effectively, if not formally, to block a hostile bid. The simulations use plausible relations among the parameters of interest and their results are striking. The simulated market makes about 28% fewer matches – acquisitions – when potential targets are permitted to choose defensive tactics levels than when not. Though there are reasons to believe that this result is artificially high, even halving it yields a significant economic result in a market, such as the market for corporate control, where the value of transactions is now over a trillion dollars a year. Thus, we believe that the simulations ground a plausible claim for more equilibrium analyses of the corporate control market.

We also revisit the shareholder welfare debate, though from a slightly different viewpoint. It has been difficult to assess the effect of various defensive tactics on shareholder welfare without a way to translate the tactics into expected value losses or gains. We suggest that the common metric among defensive tactics is delay: different tactics permit targets to forestall acquisitions for different lengths of time. Shareholder payoffs are increasing and acquirer payoffs are decreasing in the time to deal completion. We use this fact to argue that there is a unique maximizing level for each possible target. Our equilibrium simulations are illuminating here: they suggest that target boards, at least until recently, have approximated defensive tactics levels that optimally trade off the bid reducing property of defensive tactics against their surplus share increasing property. These privately optimal levels, however, much exceed the socially optimal level. Also, some firms recently may be choosing defensive tactics levels that are privately as well as socially inefficient.

Our results have substantive and methodological implications. Substantively, the results suggest that current legal rules allow a level of defensive tactics levels that are privately as well as socially inefficient. Interestingly, they also shed light on a lengthy debate between the two levels of the Delaware courts over precisely this issue. Methodologically, our results suggest the utility of evaluating defensive tactics in an equilibrium framework in addition to studying their effect on the profitability of particular companies.

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## Appendix

### *Matching Problem Model/Code Description*

All market models were crafted and simulated in Matlab, a software program designed specifically for the manipulation of matrices. Matlab allows a user to write code to generate and simulate an agent-based model under various parameters. A simulation run of the market model begins by populating a population of a specified size (in our case, 200 total agent-firms) with agent-firms of one of 6 specified types. There are 134 total A (Acquiring) agent-firms. Acquiring firms are actively seeking to match with a target firm. Of these 134 A agent-firms, 64 are synergy (AS) type acquiring firms, and 70 are hedge fund (AH) type acquiring firms. AS type acquiring firms are actively seeking to match with those target firms with whom they may form a synergistic collaboration, e.g., an auto manufacturer seeking to match with a tire manufacturer.

Synergy target firms with whom AS type firms will seek to match may be either themselves actively seeking to match with AS type firms (TA type target agent-firms), or they may be passive synergy targets who are, nonetheless, willing to match with AS type firms, if approached (TM type target agent-firms). There are 12 TA type active, synergy, target agent-firms, and 12 TM type passive, synergy, target agent-firms. AS type acquiring firms only seek to match with either TA or TM type target firms. AH type acquiring firms are actively seeking to match with mismanaged, passive target (TP) firms. There are 30 TP type passive, mismanaged, target agent-firms. AH type acquiring firms only seek to match with TP type target firms. Thus, there are 54 total T type target agent-firms: 30 TP firms, 12 TA firms, and 12 TM firms. Additionally, there are 12 passive (P) type agent-firms who neither match nor search. If either an AS or an AH or a searching TA agent-firm finds a P type firm, the searching agent-firm incurs searching costs for having searched the P type firm, but no match takes place. These P firms are the “noise firms”.

The simulations begin by randomly populating the 200 total agent-firms. Starting with TA type firms, the code randomly selects an index (i.e., a location within the population matrix). If the indexed location within the population matrix is already occupied, the code selects again until an unoccupied indexed location has been selected. Then, the code populates that indexed location with one of the TA agents. This process repeats until all of the TA agents have been placed in indexed locations within the population matrix. This process repeats for all six of the different agent-firm traits/types until the entire population matrix has been populated. The order in which the 6 different agent-firm traits/types are placed within the population matrix is: TA, TP, TM, P, AS, and AH.

Once the agent-firms have been populated, the searching process begins. All of the searching agent-firms search over the same target universe. We let acquirers make up to ten searches.[69] There are 1000 simulation runs at each search. Thus, the population matrix is repopulated 1000 times for each search. For each of the 1000 simulation runs, acquirers search once, then twice, and so forth.

For each simulation run at each search intensity, every searching agent-firm (i.e., the AS, AH, and TA agent-firms) in the population matrix has an opportunity to search for its desired match (AS firms search for TA and TP firms, AH firms search for TM firms, and TA firms search for AS firms). If a searcher has been matched when its opportunity to search comes around, it does not search. Search is terminated in two ways: a searching agent-firm is matched, either because it found a desired match or has been found by a desired match, or the next search would generate negative utility. Illustrating the latter possibility, suppose that an acquirer realizes positive expected utility at its third search, but would experience negative expected utility if it made a fourth. Then the model has this acquirer searching three possible targets.

When a match is made, only the searching agent incurs search costs; the found agent firm does not incur search costs. This is so even when the found agent is itself a searching type. Also, the agent-firm being searched, even when the search fails to result in a match, does not incur search costs. Only the searching agents incur search costs.

A simulation run unfolds as follows: The code iterates through the entire population matrix of 200 agent-firms, one by one. First, it checks to make sure that the current population member is not already matched with a partner firm. In addition to the population matrix, which is called "pop," there is a matching matrix, which is called "popMatch." The population matrix, pop, has a single column, but the matching matrix, popMatch, has two columns. The rows of the first column of the popMatch (matching) matrix are initially populated entirely with zeros (at the beginning of each new simulation run). As agent-firms are matched with one another, these rows in the first column of the popMatch matrix are filled with ones to indicate that the agent-firms in the corresponding indexed locations (rows) in the population matrix, pop, have been matched with partner firms. Thus, the first column of the matching matrix, popMatch, is populated entirely by ones and zeros. The code finds whether an agent-firm has already been matched or not, by checking the agent-firm's index in the pop matrix within the first column of the popMatch matrix; there has been a match if the indexed location (row) in the first column of the popMatch matrix is a one, but not if it is a zero. Throughout the search process, the code repeatedly checks to see if the current population member (agent-firm) has already been matched or not. This ensures that an agent-firm immediately ceases searching

[69] Restricting searches to ten is without loss of generality because, in the simulations, it is never optimal for an acquirer to take more than nine draws.

upon having achieved a desirable match, and immediately ceases incurring search costs as well. The second column of the popMatch matrix holds the indexed location (row) in the pop matrix of the agent-firm with whom the current population member is matched, if there is a match. Therefore, we know not only whether an agent-firm is matched, but with whom the firm is matched.

Once the code has checked that the current population member is not already matched with an agent-firm, the code checks whether the current population member is a searching agent-firm. To see how the simulations then proceed, suppose that the current population member is an AS – that is, a synergy searching -- firm. The code searches for a match for this firm. To begin search over 1, 2, … 10 target agents, the code randomly selects an initial agent-firm within the population matrix, pop, as its starting point. The code next checks to make sure that this initial agent-firm is not the current population member engaging in a search. The code then starts searching, iterating through the entire one draw, two draw, etc. universe, one by one, looking for desired matches for the searching population member. If the current, searcher is an AS type, the code looks for either TA or TM type firms with whom the AS type may match. If, however, the AS firm searches a TP, AS, AH or P type, then the AS firm incurs search costs in consequence of these searches, *but* it will not match with any of the searched firms. The searching AS population member will also incur search costs for searching any TA and TM firms that have already been matched. The payoffs from matches, and the costs from searches, are recorded for each population member in a matrix called "popFitness." The popFitness matrix is a single column, and the indexed location in the popFitness matrix holds the total net payoff of the agent-firm population member in the corresponding indexed location in the pop matrix. The popFitness matrix is initialized as a column of zeros at the beginning of each new simulation run.

As an example, suppose that the code is searching another AS type firm on behalf of the AS searcher, and the other AS firm is the first firm to be searched. Upon recognizing that the current firm being searched is an AS type, the code immediately checks whether or not the current, searching AS firm is already matched. This occurs before each and every instance of the code imposing costs or awarding payoffs to current, searching population members. This is so, because the current population member ceases to search and ceases to incur search costs immediately upon having achieved a desired match. Once the code has determined that the current, searching population member has not already been matched, the code imposes search costs upon the AS type for having searched another AS type firm with whom, of course, the current, searching population member does not match.

Turning to how the code calculates search costs, the cost for searching a sample of a single agent is -2 utils. We chose this value because search costs, we assume, are 2% of the match surplus, which is set at 100 utils. The code is instructed that search costs are quadratic; they vary according to sample size as follows:

$$\text{Search costs} = -2 - (\text{sample size}/10)^2 + .01$$

Thus, the search cost for searching a one target-agent is -2 utils; the search cost imposed for searching a second agent is -2.03 utils, and so on. The indexed location of the current, searching population member in the pop matrix is altered in the popFitness matrix, so that the current total net payoff of the current, searching population member reflects these search costs for having searched and failed to match with an AS type firm. The line of code appears as follows:

```
popFitness(i) = popFitness(i) + cc;
```

where cc is the variable for search costs for the possible targets searched. Remember that the popFitness matrix is initialized as a column of zeros at the beginning of each simulation run. If the current AS type had met and searched an AH or a TP or a P type agent-firm, the same cost imposition process would have occurred. This also is the case if the current AS type had met and searched either a TA or a TM type that had already been matched with a different AS type firm.

The code next turns to the next agent-firm that the AS firm may search. Suppose that this second agent firm to be searched is an unmatched TA type. The code checks whether this agent is already matched by checking the indexed location (row) in the first column of the popMatch matrix that corresponds to the indexed location (row) in the pop matrix of the TA firm being searched. If the code determines that the TA type being searched is unmatched, the code checks again to make sure that the searching AS type is unmatched. If neither firm is matched, the code makes a match, records it, charges search costs to the searching firm and allocates payoffs between the agents. In particular, the code first alters the indexed location (row) of the popFitness matrix that corresponds to the indexed location (row) in the pop matrix of the current, searching AS type population member. The popFitness matrix is altered as follows:

```
popFitness(i) = popFitness(i) + B + cc
```

where B is the payoff that an AS type firm receives for matching with a TA type firm.

To see how B is calculated, suppose that the surplus generated by a successful match is split evenly between the A (acquiring) type agent-firm and the T (target) type agent-firm. (Various splits of the surplus are possible. Asymmetric splits that favor either A or T agents are employed to approximate the markets that result from legal regimes that favor target agent defensive tactics or not.) Because we approximate the cost of searching a single agent at 2% of the surplus generated by a successful match, and we set the search cost of searching a sample of a single agent at 2 utils, B is equal to 100*(1/2). This is the payoff that an AS type agent-firm receives for successfully matching with a TA type agent-firm. The TA type agent-firm that is searched (the second of two agent-firms being searched) receives a payoff for having achieved a desired match (by being found, but not by having found a match), but incurs no search costs. The popFitness matrix is altered as follows:

popFitness(jj) = popFitness(jj) + E

where E is the payoff that a TA type firm receives for successfully matching with an AS type firm; and jj is the indexed location (row) in the pop matrix of the TA type firm that is being searched. Because the surplus generated by a successful match is being split evenly between the A (acquiring) agent-firm and the T (target) agent-firm, E also equals 100* utils (1/2). The TA agent-firm being searched incurs no search costs.

Having allotted payoffs to both firms that are now successfully matched with one another, as well as costs for having searched, the code now records the match. The code records that each is now matched, and also records who is matched with whom. First, the code places a “1” in the indexed location (row) in the first column of the popMatch matrix that corresponds to the indexed location (row) in the pop matrix of the current, searching AS type firm. Then, the code places a “1” in the indexed location (row) in the first column of the popMatch matrix that corresponds to the indexed location (row) in the pop matrix of the current TA type firm being searched. The second column of the popMatch matrix is reserved for recording the identities of the partners with whom the agent-firms are matched. An agent-firm’s identity is its indexed location (row) in the pop matrix. For example, the current, searching AS type firm’s second column of its indexed location (row) in the popMatch matrix is populated with the indexed location (row) in the pop matrix of the current TA type firm being searched. Similarly, the current TA type firm’s second column of its indexed location (row) in the popMatch matrix is populated with the indexed location (row) in the pop matrix of the current, searching AS type firm. These lines of code appear as follows:

```
popFitness(i) = popFitness(i) + B + cc;
popFitness(jj) = popFitness(jj) + E;
popMatch(jj,1) = 1;
popMatch(i,1) = 1;
popMatch(i,2) = jj;
```

popMatch(jj,2) = i;

In the example discussed above, a successful match was made, but agents may fail to match. Even so, each agent-firm member with a two draw search intensity has been searched as a potential match. Because the AS firm has exhausted its search, the code moves on to the next agent-firm in the pop matrix. And, the process continues. As mentioned above, an AS type agent-firm seeks to match with TA and TM type agent-firms, and does not match with AH, TM, and P type agent-firms. The same process described above occurs when AH and TA type agent-firms search for matches. TP and TM type agent-firms do not search, but they will match, if approached. And, P type agent-firms neither search nor match. AH type agent firms seek to match with TP type agent-firms. And, TA type agent-firms seek to match with AS type agent-firms.

When all of the searching agent-firms in the population have either had a chance to search for a desired match or have been successfully matched by having been found, then the simulation run is nearly over. It remains to record how well or poorly each agent type fared over each simulation run, and, subsequently, over the thousand simulation runs for each applicable search intensity. For each simulation run, the code records (for each agent-firm type) the number of matched agents, the total payoff of the matched agents, the total payoff for all agent-firms of that type, and the total payoff of the unmatched agents, as well as the number of agents of that type. Subsequently, the code records the averages of each of these values over the thousand simulation runs for each intensity of search.

The code also records, for each simulation run, the expected utility of each agent type, as well as the probability of matching, for each agent type. The expected utility is calculated as the total payoff of matched agents (of whichever type) plus the total payoff of unmatched agents (of whichever type), the sum of which is divided by the number of agents of that type. The probability of matching for a particular agent type is the number of actual matched agent (of whichever type) divided by the number of agents of that type. Subsequently, the code records the averages of each of these values over the thousand simulation runs for each sample size. These total payoffs, probabilities of matching, and expected utilities for the various agent-firm types are then manipulated in an excel spreadsheet to determine which markets (identified by various parameters) are more or less match efficient.

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