2017

Defensive Tactics and Optimal Search: A Simulation Approach

Ronald J. Gilson  
*Columbia Law School*, rgilson@law.columbia.edu

Alan Schwartz  
*Columbia Law School*, alan.schwartz@yale.edu

Follow this and additional works at: https://scholarship.law.columbia.edu/faculty_scholarship

Part of the Law Commons

**Recommended Citation**  
Ronald J. Gilson & Alan Schwartz, *Defensive Tactics and Optimal Search: A Simulation Approach*,  
Available at: https://scholarship.law.columbia.edu/faculty_scholarship/2023

This Working Paper is brought to you for free and open access by the Faculty Publications at Scholarship Archive. It has been accepted for inclusion in Faculty Scholarship by an authorized administrator of Scholarship Archive. For more information, please contact cls2184@columbia.edu.
Defensive Tactics and Optimal Search: 
A Simulation Approach

Ronald J. Gilson

Stanford Law School

Alan Schwartz

Yale Law School

John M. Olin Program in Law and Economics
Stanford Law School
Stanford, California 94305

Working Paper Series
Paper No. 505

This paper can be downloaded without charge from the
Social Science Research Network Electronic Paper Collection
https://ssrn.com/abstract=2920777
Defensive Tactics and Optimal Search: A Simulation Approach

by

Ronald J. Gilson
Stanford Law School; Columbia Law School;
European Corporate Governance Institute

and

Alan Schwartz
Yale Law School
Defensive Tactics and Optimal Search: A Simulation Approach

Ronald J. Gilson* and Alan Schwartz**

February 14, 2017

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; formal control largely lies with the board. Normative evaluations of current law face two obstacles. First, defensive tactics raise the social welfare question to what extent the tactics deter ex ante efficient takeovers. Theory suggests a deterrent effect because defensive tactics shift expected acquisition surplus to targets and thus reduce acquirer search. The empirical importance of the theoretical effect cannot be measured using conventional empirical techniques, however, because the researcher cannot observe deterred bids. The private welfare issue also is difficult to assess for two reasons: (a) target expected returns from acquisitions under different defensive tactics levels are partly a function of the probability of receiving bids that various tactics induce. These probabilities, in turn, are a function of how defensive tactics affect acquirer search which, as said, is difficult to measure; (b) defensive tactics have a qualitative nature. Thus, is a poison pill more or less privately efficient than a staggered board? How are target expected returns affected when a target combines a pill with a staggered board or a supermajority voting requirement? In this paper, we address these largely empirical questions by simulating a model of the market for corporate control. In the simulations, potential acquirers search sequentially for good targets. Simulations permit us to specify the number of ex ante efficient acquisitions that could be made, so we can estimate acquisition market efficiency – the ratio of made matches to good matches – under legal regimes that are more or less friendly to defensive tactics. Regarding private welfare, we argue that the common metric among defensive tactics is time: the ability

* 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.

We are extremely grateful to Sarah Braasch for creating the Matlab code that permitted us to simulate a model of the market for corporate control, and for running the simulations. This paper also benefited from workshop comments at Columbia, Georgetown and Tel Aviv law schools, the Theoretical Law and Economics Conference (2015), the American Law and Economics Association Meeting (2016), the SOIE Meeting (2016) and the Networks, Information and Business Conference, Toulouse (2016); and from comments by Albert Choi, Gerard Hertig, Edward Fox, Stephen Fraidin, Zohar Goshen, John Macey, John Morley and Roberta Romano.
of various tactics to delay bid completion and thus reduce bidder, and thereby increase target, returns. Combining this view with the search intensities that the simulated legal regimes induce permits us to estimate target expected returns.

We have two important results: First, strong defensive tactics reduce market efficiency significantly. Our simulations suggest that approximately 25% more acquisitions would be made yearly in a legal regime that is less friendly to defensive tactics. This is an economically significant result in a trillion dollar a year acquisition market. Simulations are only suggestive and our simulated model likely overstates the welfare loss. Nevertheless, the result that defensive tactics cause economically significant welfare 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. Of institutional interest, the privately optimal level of defensive tactics is better realized under the view regarding those tactics that the Delaware Chancery Court holds than under the view of the Delaware Supreme Court.

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.¹ 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?

tactics for target shareholders in that market? 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 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. The new board would then withdraw the pill, so that the shareholders could decide whether a hostile bid would succeed. 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 the 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 can catalyze the increased equity held by institutional investors, such activist campaigns are now 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

---

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. The doctrinal implications of this case are extensively analyzed in Bratton (2016).

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. Gompers, et al (2016), Krishnan, et al (2016) and Coffee and Palia (2015) describe in detail what US activist investors now do. Anand and Mihalik (2017) describe the Canadian market, which is more activist friendly.
Predictably, companies’ expanded exposure to activist campaigns induced defensive responses directed at elections rather than forced sales.\textsuperscript{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,\textsuperscript{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.\textsuperscript{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.

Despite these dynamic changes in the actors, mechanisms and targets of external capital market activity, the basic institutional question that the corporate governance debate addresses has remained 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 the opportunity to accept an offer.

\textbf{1.2 Standard Justifications for Defensive Tactics}

The standard justification for giving the board discretion to prevent shareholders from accepting a hostile offer proceeds along two tracks. First, defensive tactics permit the board to capture a larger share of the rents from an acquisition than the target shareholders could capture on their own. The second track is a more extreme form of the first. Let a board believe that the target’s value will materially increase (discounting for time and risk), but the board is unable credibly to disclose either to a bidder or to the market the basis for this belief.

\textsuperscript{4} See Gilson and Schwartz (2001). Third Point v. Ruprecht, supra note 2, involves the use of a pill designed to address an activist campaign.
The board, Delaware courts believe, should then prevent shareholders from acting directly 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 related 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 entrench itself and its management rather than to benefit shareholders.8 Because the board’s “real” motivation may be difficult to observe and impossible to verify, courts ultimately reduced their inquiry into motive to a rule-like assessment of whether a defensive tactic is either “draconian” or is “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 preclusive only if it makes a successful proxy fight “mathematically impossible or realistically unattainable.”10

1.3 The Normative and Empirical Questions

The resurgence in hostile offers, as well as defensive efforts to block activist proxy fights, have revived the earlier debate, which was whether the courts should give potential target boards great discretion to respond to bids. 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 market makes relative to the number of possible acquisitions.11 To state this measure more precisely, let \( m \) represent the number of

---

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 when, if ever, 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.

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).


10 Id., supra note 9, at 1388-89.

11 Efficiency is commonly measured in matching markets by whether matches are stable. See Azevado and Leshno (2016). This measure is satisfied definitionally in the M&A market for made matches because the target
ex ante efficient matches that could be made in a market in period 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.

Match efficiency is the appropriate welfare measure for the corporate control market because, we assume, semi-strong informational 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 exceeds its stand-alone value.\(^{12}\) If every actual match is ex ante efficient, the welfare question is how close the market comes to making all of the possible efficient matches. Put another way, \( \sigma \) is a relatively inclusive social welfare measure because, on an expected basis, completed deals create gains in excess of costs. The target welfare question is less complex: defensive tactics disappears into the acquirer. Two other social welfare measures appear in the corporate control 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, et al (2003). We do not address this second measure here.

\(^{12}\) Recent evidence is consistent with our assumption that most matches are ex ante efficient. See Arikan and Stulz (2016) at 140, 141 (“We find strong support for the predictions of neoclassical theories that acquisitions are made by better performing firms and firms with better growth opportunities, and that acquisitions create value. ... Our evidence of a positive relation between a firm’s acquisition rate and its Tobin’s q supports the neoclassical view of acquisitions, which holds that firms use acquisitions to reallocate corporate assets to more productive uses.”); Makismovic, et al (2013) at 2179 (“We find that acquisitions are efficiency improving, both on and off the [merger] wave.”). 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. A potentially large source of inefficiency exists in stock for stock mergers because acquirers may bid with overvalued shares, thereby purchasing targets though other bidders have higher valuations. Li, et al (2016) use a structural model to estimate the magnitude of the inefficiency, with a sample of 2,503 deals from 1980 to 2013, finding “that an overvalued bidder crowds out a bidder with a higher synergy in 7% of the deals ... the aggregate efficiency loss is 0.63% of the target’s pre-announcement value, with a standard error of 0.19%”. (at 3).
maximize shareholder welfare when they maximize the target shareholders’ expected return from a possible sale of the company.

The Delaware courts have not pursued the social welfare question. The fiduciary duty of directors runs to the company and its shareholders, not to shareholders generally. Hence, when Delaware courts evaluate defensive tactics, the question for them is how those tactics affect target shareholder value, not how the tactics affect the welfare of shareholders in other companies. The courts’ largely exclusive focus on shareholders of the target company thus elides, rather than responds to, the social welfare question. Indeed, if a target board agrees to consider acquisition offers, Delaware law requires the board to maximize the price.\(^\text{13}\)

If match efficiency is the social welfare measure, the concern is that defensive tactics could reduce hostile bids because the tactics shift acquisition surplus from acquirers to targets. Because acquirers then gain less from acquisitions, they may search less for targets to buy.\(^\text{14}\) This concern is difficult to evaluate for two reasons. First, some potential targets search for firms that want to buy them. The corporate control market thus is partly a traditional active buyer/ passive seller market and partly a matching market. Banning defensive tactics could reduce the incentive of targets to match by shifting surplus back to acquirers. This raises the question which side of the market the law should encourage. Earlier economic analyses elided this question because commentators assumed that the corporate control market was similar to ordinary markets: there only were passive sellers – the potential targets – and active shoppers – the potential acquirers.

Second, and as explained further below, the market is quite heterogeneous. There are acquirers that search for synergy matches – the “strategic buyers” – and acquirers that search for mismanaged firms to improve – the “financial buyers”. On the selling side, some potential synergy targets are passive but will respond to offers and, as said, some potential synergy targets themselves search. There also are mismanaged firms that are passive because they

\(^{14}\) A recent paper estimated that target resistance explains 74\% of the premium in single bidder contests. See Dimopoulos and Sacchetto (2014). Hence, it is plausible to suppose that potential acquirers consider the effect of defensive tactics on their likely share of acquisition surplus when choosing search intensities.
prefer not to be discovered. In addition, there are what we call “noise firms” that are not in play. A noise firm is either (a) a well-managed firm that a financial buyer could not improve but also is a poor synergy match for the synergy searchers then in the market; or (b) a firm that has chosen a defensive tactics level so high that no acquirer could profitably purchase it. Market heterogeneity matters, because, we assume, it is costly for a potential acquirer to decide into which category a potential target fits. Hence, potential acquirers may waste costs searching over the “wrong” targets: search effectiveness, that is, falls as sell-side heterogeneity increases.

Because of the corporate control market’s complexity, the theoretical literature is less helpful than it usually is. Standard matching models fit the market poorly because, in these models, both sides of the market search in order to match. Here, much of the selling side does not search and an important fraction of it – the mismanaged firms – prefers not to match. 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. Standard search models also do not fit this market because in those models only buyers search and every seller wants to trade (at some price). 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 likely reduce. 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. The question thus is empirical: do targets choose defensive tactics levels that approximate the privately optimal level?

Both welfare questions are difficult to answer using standard empirical methods. Indeed, those methods cannot answer the social welfare question when the efficiency measure

---

15 These noise firms may be mismanaged or attempting to protect their hidden value. See text at note 7 above.
16 Galenianos and Kircher (2012) provide a general review of search models in which one side searches and the other side sets prices. Schwartz (1986) uses this genre of model to criticize defensive tactics.
is the number of made matches as a percentage of the number of possible made matches. This is because the econometrician can observe concluded and failed bids under an existing legal regime but she cannot observe the total number of possible good matches in that regime. Hence, she cannot estimate the regime’s success in making matches. Partly as a result of this difficulty, the extensive corporate governance research has focused on the private welfare question.

Empirical research into target welfare, though illuminating, has been hampered by two difficulties, however. First, defensive tactics affect the equilibrium intensity of search; in turn, the target should take the expected intensity of search into account when choosing its defensive tactics level. As said, characterizing equilibrium search in this market has proved elusive. Second, empirical research is handicapped by the qualitative aspects of defensive tactics. A poison pill, for example, permits a target board to reject bids and, to some extent, 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 in different circumstances. Such a metric has not been identified so far.17

1.4. Methodology, Theoretical Predictions and Results

Our paper is empirical, though in a particular sense. Because we cannot measure actual market performance, we simulate a simple search model of the corporate control market. The simulations are described in detail in Part 2; we introduce our methodology here. Analysis begins with creating sets of acquirers and targets. Targets either are companies whose stand-alone value can be improved by acquirer imposed changes in strategy or management (financial buyer opportunities), or targets whose value is increased by combining their activities with

17 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 tactics and by what appear to be errors in the coding of the data bases typically used to identify companies’ existing defensive tactics. See Catan and Kahan (2016); Larcker, et al (2016); Klausner (2015).
those of the acquirer (synergy buyer 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 agent types search sequentially, analyzing potential matches until either the agent makes a match or the marginal 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. We attempt to characterize two legal regimes. The first regime is unfriendly to defensive tactics and resembles the pre-1985 Delaware law regime, under which defensive tactics were either absent or largely ineffective. The second regime resembles the corporate control market today. As said, defensive tactics affect how surplus is split between acquirers and targets. Because we have specified the number of good matches in the simulated markets, 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.

Turning to theoretical predictions and results, target search should complement acquirer search because targets and acquirers are searching for match partners. In our simulations, acquirer returns do increase in target search. Nevertheless, it is more important to encourage acquirer search because, in our model, all of the acquirers search for targets but only a subset of targets search for acquirers. Therefore, though acquirer and target search are complements, discouraging acquirer search has a greater negative effect on the number of made matches than discouraging target search.

Further, when efficiency is measured by made matches, and the number of made matches is increasing in the amount of search, theory holds that searchers should realize the entire surplus from matches. It has been recognized for a long time that this is impossible
when both sides of the market search. Here, some targets search. Also, each acquisition target is importantly unique. Thus, acquisitions resemble bilateral monopoly cases, in which both sides come away with something. Nonetheless, theory suggests that defensive tactics should be restricted because there is a positive correlation between acquirer search intensity and made matches. As a consequence, our contribution here is empirical: we attempt to illuminate the magnitude of the inefficiency caused by giving target boards almost complete discretion to choose defensive tactics levels. In our simulations, the current legal regime is much less match efficient than the earlier regime. The surplus split under our assumed defensive tactics-friendly regime yields approximately 75% 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. Thus, to the extent that our simulations approximate reality, a legally enabled 18% reduction in the number of matches is an economically important effect.

Turning to shareholder welfare, theory predicts that targets should choose defensive tactics levels that are higher than is socially optimal. This is because these tactics create a negative search externality. The corporate control market contains many potential targets; hence, the defensive tactics level a particular possible target chooses cannot affect the market average defensive tactics level. Thus, each potential target chooses the defensive tactics level that is optimal for it, but does not consider the search dampening effect of its and the other potential targets’ choices on the average market level. Acquirers, however, use the average level when choosing search intensities. As a consequence, acquirers should search too little and the market should be less match efficient than it could be.

---

18 “If the surplus value of the match is divided equally between the partners, then all agents invest too little in search effort because none accounts for the share of the surplus gained by the future partner were the agent to make the match. Search efforts made by all in a Nash equilibrium are efficient when the matchmaker receives all the surplus ....” Mortensen (1982) at 977.
19 “Although efficient search obtains when the matchmaker takes all the surplus, the members of any particular pair are not likely to divide the surplus in this way, ex post. Once they meet, the two face a bilateral bargaining problem with other more plausible solutions.” Id. at 975.
20 We note here a methodological observation: “simulations have proven to be useful for generating conjectures, and can be essential for developing quantitative results”. Fudenberg and Levine. (2016 at 165-66).
21 Li, et al. (2016).
Again the task here is to estimate the magnitude of the theoretical effect. This task is eased because we have market results. Difficulties remain, however, because of the lack of a common metric by which to assess various defensive tactics. In our view, a common metric does exist: *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 payoff – its surplus share – declines as the time increases between finding a possible target and 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.\(^2\) Therefore, 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.

Using the common metric of time, we argue that there is a delay facilitating defensive tactics level for each target that maximizes the target’s expected return from a possible sale of the company.\(^{23}\) In our simulations, a target’s expected return, as a function of the defensive tactics level it chooses, is maximized when targets realize approximately 62% percent of acquisition surplus. The market evidence, though a little dated, suggests that actual targets realize approximately 67% of surplus.\(^{24}\) Thus, target boards, by and large, may be faithful fiduciaries regarding sales of the company. On the other hand, and as predicted, the conflict between individual and collective rationality exists: the defensive tactics levels that are optimal

\(^{22}\) 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.

\(^{24}\) That our simulated maximizing target defensive tactics level approximates the apparent market average level is consistent with the simulations capturing real phenomena.
for potential targets are much higher than the levels that once existed, and produce fewer matches.

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 shareholder welfare results are evidence that the discussion over the desirability of defensive tactics should resume. Also, we want to situate defensive tactics in the larger debate about the desirability of shareholder control. Our preliminary results suggest that defensive tactics 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. But potential targets still have weapons to use against activists, and may develop more with time. Thus, we suggest that the defensive tactics issue should again occupy a prominent place in the corporate governance debate.

A final point concerns 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 have the position 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

25 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 these were records. See David Benoit, “Activists Win Seat at the Table”, WSJ Dec. 26-27 (2015), section 1, at pp. 1, 8.
26 See Third Point v. Ruprecht, supra note 3.
addresses normative objections to our analysis. Part 3 then closes with a discussion of the early (pre-1985) Delaware Chancery Court legal regime and compares that regime to the current regime. Our analysis suggests that the Delaware courts had it right the first time. Part 4 concludes. Appendix 1 describes the coding and search algorithms our Matlab program uses.

2. The Simulated Market for Corporate Control

2.1: The Agents

The actual number of acquirers, targets and noise firms at any one time is not known. We thus had two objectives when populating the simulated market: to have enough agents to get interpretable results and to be faithful to the views of actual market participants, who use needle in a haystack metaphors to say that productive search is extensive and time consuming. Turning to what we did, all of the agents are risk neutral. A target is a “live prospect”: a firm that would be a good match for the appropriate acquirer. An acquirer makes at most one match per period. There are sixteen possible synergy sellers who do not search for acquirers – the passive targets; sixteen active possible synergy sellers who search for acquirers – the active targets; and thirty-five mismanaged targets that are passive because they prefer to be anonymous. Hence, there are sixty-seven ex ante efficient transactions in the relevant period.

27 There also are 265 noise firms. On the buying side, there are 140 financial buyers and 128 strategic, or synergy, buyers. The total market population is 600.

Acquirers definitionally search but relatively few synergy targets search, 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 buy another firm or sell itself to another firm. Success in a synergy motivated acquisition requires both search and

27 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 it is difficult to assess the magnitude of the effect.
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 repeated acquisitions. Summing up, we assume that a relatively small subset of potential targets is searching for acquirers.

2.2 Search Strategies

In the standard search model, potential buyers learn prices only by visiting the firms that set those prices. Choosing a defensive tactics level is, in effect, choosing a price because the level importantly determines the split of acquisition surplus. Thus, we also assume that searchers learn the defensive tactics levels at particular firms only by visiting those firms. Searching for targets differs from searching for prices, however, because prices are immediately apparent while determining a potential target’s defensive tactics level requires investigation, and then inferring the likely price range within which the target will sell requires analysis. A serious investigation is similar to a serious price search in a particular sense, though: both often let the seller know that it is visited.

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 searched target is likely to learn that it is in play. The target may then use the defensive tactics that it had adopted to increase the price. For example, it is common for a firm with poison pill

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.
protection to attempt to find other bidders. The corporate control searcher thus often cannot return to the “same” firm that it initially visited. Therefore, acquirers in the model search sequentially: that is, until either the acquirer finds a match or the next search would yield negative expected gains. In the former case, the agent bids; in the latter case, the agent exits.

The number of searches agents make is a function of search costs and prospective gains. We assume that it costs about two percent of match surplus to make one search. The analyst may assume either constant or increasing search costs. Increasing costs seems the more realistic assumption here because acquirers likely begin search for potential targets in areas that are familiar to the acquirers, and then search for targets in less familiar areas. Potential targets in the latter areas should be more costly for an acquirer to evaluate. Search costs per target thus should increase as prior searches do not eventuate in matches. In the model, then, searching two firms costs a searcher more than would just doubling the cost of searching one firm.

Because we are attempting to simulate market outcomes, we need, as far as the data permit, to quantify surplus splits under the two legal regimes we analyze. This is difficult to do because the empirical observer cannot conveniently observe actual surplus splits. We proceed 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 \( v \): the winning bid is \( b \). We let \( b = (1 + \alpha)p \), where \( 0 < \alpha < \infty \) is the premium necessary to induce shareholders to tender; and \( v = (1 + \beta)p \),

---

30 Data about actual search costs is difficult to observe. Breakup fees compensate a bidder for search costs if a target that had previously accepted a bid instead takes a higher bid. These fees are observable and today approach 4% of deal value. Restrepo and Subramanian (2017). A recent paper estimated bidder surplus at .8 of deal value. Dimopoulos and Sacchetto (2014). To take 4% of this estimate would imply an initial search cost of 3.2% of deal surplus. It is less costly to evaluate a firm and to move on than both to analyze the firm and bid, however. Thus, we reduce this cost estimate by about a third. Note 48, infra, suggests that the resultant 2% figure may be low.

31 In the simulations, the surplus from a deal is 100 utils, which the sellers and buyers divide. 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 = \(-2\cdot - (\text{sample size})/10\cdot\text{sample*sample}) + .01\). This function is quadratic over whole integers such as the number of sequential searches an acquirer makes. We note here that constant marginal search costs would be the reasonable assumption if every seller is as convenient to evaluate as every other seller. Standard search models thus often assume constant marginal costs because the agent is just observing each visited firm’s price. In contrast, it is plausible to assume that it is more costly for an acquirer to visit, say, the third potential target than to visit the first because acquirers order search, beginning with the potential targets (or industries) they know best.
where $0 < \beta \leq \infty$ reflects the acquirer's expected value as a function of the target's pre-bid price. The acquirer's return thus 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 $\lambda$ of the surplus from a completed transaction, where $\lambda = \frac{p(\beta - \alpha)}{p\beta} = \frac{\beta - \alpha}{\beta}$. This is less than one because $\alpha > 0$ and $\beta > \alpha$.

A searching acquirer expects to realize less than $\lambda$ of a deal's surplus, however, because a target that is searched often will know that it is in play and may attempt to interest other bidders. Our matlab program assumes that every target that is searched by the appropriate acquirer (i.e., synergy target by synergy searcher) is acquired. This assumption is relatively realistic; a recent study estimated the fraction of initial bidders that acquire targets as .9. However, this fraction falls if other bidders enter. Another 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. Analysis and these results thus suggest that while a successful acquirer realizes $\lambda$ of the deal's surplus, a target choosing its search intensity will discount $\lambda$ by the probability that the acquirer will lose a target it uncovers to another acquirer. Because strong defensive tactics, such as poison pills and staggered boards, increase a target's ability to find other bidders or otherwise to resist, a searching acquirer that finds a target should consummate a sale with a lower probability under strong defensive tactics than under weak defensive tactics, whether because defensive tactics allow the target to remain independent or because they allow the target to initiate an auction. In notation, an acquirer buys a target with

---

32 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 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.

33 Dimopoulos and Sacchetto (2014). Heron and Lie (2015) also find that multiple entrants reduce the likelihood that the initial bidder succeeds but do not increase the probability that the target remains independent.

probability $\tau^i < 1$, where $i \in \{w, s\}$ and $\tau^s < \tau^w$. Hence, an acquirer’s expected gain from finding a target is $\tau^i \lambda \tau^i$ times the expected match surplus.\(^{35}\)

Regarding 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 $\alpha$ in the algorithm above) and estimated an average acquirer value above the pre-bid price of .81 (the $\beta$).\(^{36}\) Using the algorithm, an acquirer’s surplus share from completing an acquisition would be .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 are thought to be 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 defensive tactics-unfriendly regime split of 2/3 for acquirers and 1/3 for targets. Then reasoning roughly from the empirical studies cited above, we assume $\tau^s = .75$ (under strong defensive tactics the first acquirer to find an eligible target succeeds in acquiring it with probability .75) and $\tau^w = (1.1)\tau^s$.

It also is necessary to specify how targets choose defensive tactics levels and how those levels map into surplus splits. We undertake this task later in Part 3 because this Part focuses on acquirers, who take defensive tactics levels as given. Also, the shareholder welfare question implicates corporate governance issues that should be expressly addressed. We note here, however, that while a target cannot affect the market average defensive tactics level by the level it chooses, the target can affect the probability with which it will be bought. To see why, realize that a sequential searcher may pass on a firm whose defensive tactics level seems high in light of the acquirer’s view of the market distribution. Recalling that choosing a defensive tactics level

\(^{35}\) 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.

\(^{36}\) See Dimopoulos and Sacchetto (2014). A more recent paper studied acquisitions between 2001 and 2010 and found a premium over the price when the market first learned that a company was, or would likely be, a target of 51.4%. See Mulherin and Simsir (2015 at p.2 and Table IV). This study did not calculate bidder values as a percent of the pre-bid price. 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 not uncommon, and other plausible conditions obtain, tender offers can be profitable for bidders.
tactics level, in effect, is choosing a price, our targets thus act as do sellers in standard search models, whose choice of a price cannot affect the market price distribution but can affect the individual seller’s demand.

Turning to timing, at the beginning of a period, potential acquirers choose search strategies and potential targets and noise firms choose defensive tactics levels. Each potential acquirer then searches until it matches or further searches would be unprofitable; the unsuccessful acquirer then exits the market. As said, targets that are searched may use the defensive tactics they have adopted. As an example, because a target board can adopt a poison pill in hours, and because pills increase target bargaining power, acquirers assume that every target has a pill. A searched target without a pill likely then will adopt one. Equilibrium in the model has acquirers not varying their search strategies and targets not varying, though possibly acting on, their defensive tactics levels.

2.3 Results

2.3.1 Method

We simulate the model as follows.\(^{37}\) 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.\(^ {38}\) 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 surplus share when beginning to search is its split conditional on making a match times the probability of buying the target it discovers, or .33 times .75 = 25%, times the match surplus.\(^ {39}\) An agent’s expected utility from a search is reported as the average of a thousand simulations for each one of the possible draws.

---

37 Appendix 1 sets out in greater detail how the model unfolds.
38 Recalling that the Program measures results in utils, we report expected utility as whole numbers and fractions of utils: e.g. 2.35.
39 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
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.

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 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 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 67 (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.

40 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.

40 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 acquirer costs are incurred in making full investigations. We know that some acquirers use investment bankers while others do not, but the relative fraction of banker users is unknown. For these reasons,
2.3.2: Results

We begin with a base case as a benchmark: in it, there is one acquirer type and one target type, which does not search. Our results are the two Tables below. An AH agent is an acquirer and a T agent is a passive target. A row with zeros indicates that this type of agent was not active in the market. To interpret the Tables, realize that every target now is assumed to be a good match for every acquirer so wasted searches occur only when an acquirer hits a noise firm. Acquirers search – investigate and analyze firms -- until they find a desirable target or until the next search would yield negative utility. Table 1 characterizes the defensive tactics unfriendly regime, in which acquirers expect to realize .55 of the surplus and targets expect to realize the remainder. Table 2 characterizes the defensive tactics unfriendly regime, in which acquirers expect to realize .25 of the surplus. The simulations develop results for from one to 18 searches (a “sample size” in a Table) but, to improve readability, all of the Tables set out below report only searches shortly before and shortly after an agent stops searching.\footnote{Complete results are available on request.}

Table 1

---

\footnote{Complete results are available on request.}


Table 2

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob TF (67)</td>
<td>0.976</td>
<td>0.9824</td>
<td>0.9847</td>
<td>0.9854</td>
<td>0.9839</td>
<td>0.9831</td>
</tr>
<tr>
<td>Prob TA (0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Prob TM (0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sigma</td>
<td>0.976</td>
<td>0.9824</td>
<td>0.9847</td>
<td>0.9854</td>
<td>0.9839</td>
<td>0.9831</td>
</tr>
<tr>
<td>Sigma TP</td>
<td>0.2447</td>
<td>0.2456</td>
<td>0.2462</td>
<td>0.2463</td>
<td>0.2463</td>
<td>0.2463</td>
</tr>
<tr>
<td>Sigma TA &amp; TM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sigma A</td>
<td>0.976</td>
<td>0.9824</td>
<td>0.9847</td>
<td>0.9854</td>
<td>0.9839</td>
<td>0.9831</td>
</tr>
<tr>
<td>Sigma AIH</td>
<td>0.976</td>
<td>0.9824</td>
<td>0.9847</td>
<td>0.9854</td>
<td>0.9839</td>
<td>0.9831</td>
</tr>
<tr>
<td>Total TF Payoff</td>
<td>2,106,4</td>
<td>2,193,9</td>
<td>2,199,2</td>
<td>2,208,6</td>
<td>2,208,6</td>
<td>2,208,6</td>
</tr>
<tr>
<td>Total TA Payoff</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total TM Payoff</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total TF Payoff</td>
<td>2,106,4</td>
<td>2,193,9</td>
<td>2,199,2</td>
<td>2,208,6</td>
<td>2,208,6</td>
<td>2,208,6</td>
</tr>
<tr>
<td>Total TA Payoff</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total TM Payoff</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Payoff (Welfare)</td>
<td>285,17</td>
<td>295,34</td>
<td>22,18</td>
<td>187,14</td>
<td>153,18</td>
<td>115,31</td>
</tr>
<tr>
<td>Payoff per Match Made</td>
<td>43,630,884</td>
<td>38,641,206</td>
<td>33,629,591</td>
<td>28,390,225</td>
<td>22,393,635</td>
<td>17,417,181</td>
</tr>
<tr>
<td>A Agent Expected Utility</td>
<td>3.48905257</td>
<td>3.30410448</td>
<td>0.07276116</td>
<td>-1.2174642</td>
<td>-2.5555731</td>
<td>-3.9317836</td>
</tr>
<tr>
<td>Target Agent Expected Utility</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Agent Expected Utility</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Agent Expected Utility</td>
<td>2.4890</td>
<td>3.3041</td>
<td>0.0728</td>
<td>-1.2175</td>
<td>-2.5556</td>
<td>-3.9318</td>
</tr>
<tr>
<td>TP Agent Expected Utility</td>
<td>32.6328</td>
<td>32.7455</td>
<td>32.8525</td>
<td>32.8545</td>
<td>32.8565</td>
<td>32.8585</td>
</tr>
<tr>
<td>TA Agent Expected Utility</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Agent Expected Utility</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Expected Welfare</td>
<td>42.5925373</td>
<td>37.9611943</td>
<td>33.1140754</td>
<td>27.9761794</td>
<td>22.5400299</td>
<td>17.2104478</td>
</tr>
</tbody>
</table>
When the defensive tactics-friendly legal regime governs -- the surplus split favors targets -- acquirers make seven searches and there are 60.15 matches, yielding a sigma of .918. In the defensive tactics-unfriendly legal regime, where the split favors acquirers, the acquirers search fifteen firms and there are almost 66 matches, yielding a σ of .984. The defensive tactics-friendly regime thus produces a match inefficiency of about 6% – the fraction of matches that could have been made but were not.

The base case is unrealistic because it assumes that all acquirers are alike and all targets are alike. In a more accurate characterization of the market, there are two types of acquirers: financial buyers and strategic buyers. A financial buyer, often a private equity fund, 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.42 Thus, there are three types of targets: mismanaged firms, which do not search,

---

42 See Gorbenko and Malenko (2014).
passive potential synergy targets, and active potential synergy targets that themselves search for a partner.

A corporate control market with a more realistic set of actors 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. 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. On the other hand, we now let some targets search. However, heterogeneity also affects their search strategies. First, searching synergy targets will pass over financial acquirers because synergy is not possible. Second, strong 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 more sensitive to the surplus split the more that the split goes against the acquirer. Hence, acquirers should truncate search substantially when the probability that a searched firm is a good target falls materially, 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 Tables 3 and 4. In the Tables, an AH agent is a financial buyer who is searching for a mismanaged firm; 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 3 characterizes the defensive tactics friendly legal regime; Table 4 characterizes the defensive tactics unfriendly regime.

---

43 Schwartz and Wilde (1982) first show that search becomes less effective as market agents become more heterogeneous.
### Table 3

Larger Set of Agents with 2% Costs (600 Agents – 248 A's (140 AFs); 128 A's; 265 P's; 67 T's (16 TA's); 35 TP's; 16 TM's)

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob TP (35)</td>
<td>0.916</td>
<td>0.905</td>
<td>0.895</td>
<td>0.884</td>
<td>0.874</td>
<td>0.864</td>
</tr>
<tr>
<td>Prob TA (16)</td>
<td>0.904</td>
<td>0.893</td>
<td>0.882</td>
<td>0.871</td>
<td>0.860</td>
<td>0.850</td>
</tr>
<tr>
<td>Prob TM (161)</td>
<td>0.944</td>
<td>0.934</td>
<td>0.923</td>
<td>0.912</td>
<td>0.901</td>
<td>0.890</td>
</tr>
<tr>
<td>Sigma TP</td>
<td>0.625</td>
<td>0.615</td>
<td>0.605</td>
<td>0.595</td>
<td>0.585</td>
<td>0.575</td>
</tr>
<tr>
<td>Sigma TA &amp; TM</td>
<td>0.561</td>
<td>0.551</td>
<td>0.541</td>
<td>0.531</td>
<td>0.521</td>
<td>0.511</td>
</tr>
<tr>
<td>Sigma TM</td>
<td>0.544</td>
<td>0.534</td>
<td>0.524</td>
<td>0.514</td>
<td>0.504</td>
<td>0.494</td>
</tr>
<tr>
<td>Sigma A</td>
<td>0.396</td>
<td>0.386</td>
<td>0.376</td>
<td>0.366</td>
<td>0.356</td>
<td>0.346</td>
</tr>
<tr>
<td>Sigma All</td>
<td>0.373</td>
<td>0.363</td>
<td>0.353</td>
<td>0.343</td>
<td>0.333</td>
<td>0.323</td>
</tr>
<tr>
<td>Sigma A</td>
<td>0.163</td>
<td>0.153</td>
<td>0.143</td>
<td>0.133</td>
<td>0.123</td>
<td>0.113</td>
</tr>
<tr>
<td>A Match Made</td>
<td>41.74</td>
<td>40.65</td>
<td>40.56</td>
<td>40.47</td>
<td>40.38</td>
<td>40.29</td>
</tr>
<tr>
<td>Total Match Made</td>
<td>41.57</td>
<td>40.48</td>
<td>40.40</td>
<td>40.31</td>
<td>40.23</td>
<td>40.14</td>
</tr>
<tr>
<td>Total AS Payoff</td>
<td>189.9</td>
<td>179.5</td>
<td>169.1</td>
<td>158.7</td>
<td>148.3</td>
<td>137.9</td>
</tr>
<tr>
<td>Total AS Payoff</td>
<td>190.3</td>
<td>189.9</td>
<td>189.5</td>
<td>189.1</td>
<td>188.7</td>
<td>188.3</td>
</tr>
<tr>
<td>Total TA Payoff</td>
<td>270.8</td>
<td>250.6</td>
<td>230.4</td>
<td>210.2</td>
<td>190.0</td>
<td>179.8</td>
</tr>
<tr>
<td>Total TM Payoff</td>
<td>271.2</td>
<td>251.0</td>
<td>230.8</td>
<td>210.6</td>
<td>190.4</td>
<td>179.9</td>
</tr>
<tr>
<td>Total TA Payoff</td>
<td>271.5</td>
<td>251.3</td>
<td>231.1</td>
<td>210.9</td>
<td>190.7</td>
<td>179.6</td>
</tr>
<tr>
<td>Total TM Payoff</td>
<td>271.9</td>
<td>251.7</td>
<td>231.5</td>
<td>211.3</td>
<td>191.0</td>
<td>179.9</td>
</tr>
<tr>
<td>Total Payoff (Welfare)</td>
<td>71.71</td>
<td>69.23</td>
<td>66.75</td>
<td>64.27</td>
<td>61.79</td>
<td>59.31</td>
</tr>
<tr>
<td>Payoff per Match Made</td>
<td>31.71</td>
<td>30.42</td>
<td>29.13</td>
<td>27.84</td>
<td>26.55</td>
<td>25.26</td>
</tr>
</tbody>
</table>

### Table 4

Larger Set of Agents with 2% Costs (600 Agents – 248 A's (140 AFs); 128 A's; 265 P's; 67 T's (16 TA's); 35 TP's; 16 TM's)

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob TP (35)</td>
<td>0.895</td>
<td>0.905</td>
<td>0.916</td>
<td>0.926</td>
<td>0.936</td>
<td>0.946</td>
</tr>
<tr>
<td>Prob TA (16)</td>
<td>0.885</td>
<td>0.895</td>
<td>0.906</td>
<td>0.916</td>
<td>0.926</td>
<td>0.936</td>
</tr>
<tr>
<td>Prob TM (161)</td>
<td>0.875</td>
<td>0.885</td>
<td>0.895</td>
<td>0.905</td>
<td>0.915</td>
<td>0.925</td>
</tr>
<tr>
<td>Sigma TP</td>
<td>0.561</td>
<td>0.551</td>
<td>0.541</td>
<td>0.531</td>
<td>0.521</td>
<td>0.511</td>
</tr>
<tr>
<td>Sigma TA &amp; TM</td>
<td>0.544</td>
<td>0.534</td>
<td>0.524</td>
<td>0.514</td>
<td>0.504</td>
<td>0.494</td>
</tr>
<tr>
<td>Sigma TM</td>
<td>0.527</td>
<td>0.517</td>
<td>0.507</td>
<td>0.497</td>
<td>0.487</td>
<td>0.477</td>
</tr>
<tr>
<td>Sigma A</td>
<td>0.373</td>
<td>0.363</td>
<td>0.353</td>
<td>0.343</td>
<td>0.333</td>
<td>0.323</td>
</tr>
<tr>
<td>Sigma All</td>
<td>0.350</td>
<td>0.340</td>
<td>0.330</td>
<td>0.320</td>
<td>0.310</td>
<td>0.300</td>
</tr>
<tr>
<td>Sigma A</td>
<td>0.163</td>
<td>0.153</td>
<td>0.143</td>
<td>0.133</td>
<td>0.123</td>
<td>0.113</td>
</tr>
<tr>
<td>A Match Made</td>
<td>41.74</td>
<td>40.65</td>
<td>40.56</td>
<td>40.47</td>
<td>40.38</td>
<td>40.29</td>
</tr>
<tr>
<td>Total Match Made</td>
<td>41.57</td>
<td>40.48</td>
<td>40.40</td>
<td>40.31</td>
<td>40.23</td>
<td>40.14</td>
</tr>
<tr>
<td>Total AS Payoff</td>
<td>189.9</td>
<td>179.5</td>
<td>169.1</td>
<td>158.7</td>
<td>148.3</td>
<td>137.9</td>
</tr>
<tr>
<td>Total AS Payoff</td>
<td>190.3</td>
<td>189.9</td>
<td>189.5</td>
<td>189.1</td>
<td>188.7</td>
<td>188.3</td>
</tr>
<tr>
<td>Total TA Payoff</td>
<td>270.8</td>
<td>250.6</td>
<td>230.4</td>
<td>210.2</td>
<td>190.0</td>
<td>179.8</td>
</tr>
<tr>
<td>Total TM Payoff</td>
<td>271.2</td>
<td>251.0</td>
<td>230.8</td>
<td>210.6</td>
<td>190.4</td>
<td>179.9</td>
</tr>
<tr>
<td>Total TA Payoff</td>
<td>271.5</td>
<td>251.3</td>
<td>231.1</td>
<td>210.9</td>
<td>190.7</td>
<td>179.6</td>
</tr>
<tr>
<td>Total TM Payoff</td>
<td>271.9</td>
<td>251.7</td>
<td>231.5</td>
<td>211.3</td>
<td>191.0</td>
<td>179.9</td>
</tr>
<tr>
<td>Total Payoff (Welfare)</td>
<td>71.71</td>
<td>69.23</td>
<td>66.75</td>
<td>64.27</td>
<td>61.79</td>
<td>59.31</td>
</tr>
<tr>
<td>Payoff per Match Made</td>
<td>31.71</td>
<td>30.42</td>
<td>29.13</td>
<td>27.84</td>
<td>26.55</td>
<td>25.26</td>
</tr>
</tbody>
</table>

Expected Welfare | 44.938858 | 47.46156 | 49.9303449 | 48.1597218 | 46.4882597 | 45.9044779 |
In the defensive tactics unfriendly regime, the financial and strategic buyers make fourteen searches that eventuate in 62.54 matches -- a sigma of .935. In the defensive tactics friendly regime, both the financial buyers and the strategic buyers make six searches. The number of matches falls to 53.22, yielding a sigma of .75. An illuminating way to put this result is that moving from the defensive tactics friendly regime to the defensive tactics unfriendly regime would increase the number of matches by 25%.\textsuperscript{44} Regarding the differences between the base case and the realistic case, (a) The realistic case is match inefficient relative to the base case; there are fewer matches under both legal regimes in the realistic market; and (b) the efficiency gap between the defensive tactics friendly and defensive tactics unfriendly legal regimes is significantly wider in the realistic case than in the base case.\textsuperscript{45}

To summarize, practitioners and some academics argue that defensive tactics deter an immaterial number of bids because there are 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 permits potential targets to shift expected acquisition surplus in their favor. The deal value of acquisitions made in the corporate control market each year was recently estimated at a little over a trillion dollars. Under a defensive-tactics-unfriendly legal regime, our simulations show, the market could make approximately 25% 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.\textsuperscript{46}

\textsuperscript{44} Regarding this calculation \((.935 - .750)/.750 = .25\). This match inefficiency obtains although, in the realistic case, some synergy targets also are searching.

\textsuperscript{45} These results are consistent with theoretical predictions. 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 legal regime should widen. Our simulations yield these results.

\textsuperscript{46} Comparing the possible inefficiency here to others that have recently been uncovered, a recent paper measured the 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). Another paper estimated the welfare loss that price dispersion caused, due importantly to inefficient search, in the credit card market. If every
Our simulations overstate the search inefficiency, however, for four reasons. First, some acquisitions turn out to be unsuccessful. The welfare loss from mistaken matches should be subtracted from the welfare loss from lost matches. Second, our Matlab program counts an acquirer’s visit to a target that has already been matched as a wasted search. This seems unrealistic because, in reality, matched firms likely look different from unmatched firms because the matched firms have been bought. Hence, actual acquirers may not search matched firms intensely. Because the program overstates wasted searches, it understates market efficiency. Third, some acquisitions may be ex ante inefficient because of empire building by the acquirer’s management or because an acquirer is buying with overvalued stock. 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 a better chance of narrowing search to productive areas than our model permits. On the other hand, we may understate the market inefficiency. All in all, however, the simulation parameters are plausible, the qualitative results are in accord with theoretical predictions and the defensive tactics inefficiency is large. Even if the four qualifications just noted reduce the simulated inefficiency by half, the simulated market would still make almost 13% fewer matches under the defensive tactics friendly regime than under the defensive tactics unfriendly regime.

consumer purchased at the lowest market price, welfare (exclusive of search costs) would improve by $36 billion per year. Stango and Zinman (2015). Perhaps more directly in point, Li, et al (2016) estimate the welfare loss from bidders purchasing with overvalued shares at $4.4 billion a year in lost synergies.

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.

There are three reasons. First, we implicitly assume that lawyer and investment banker fees are invariant to the legal regime. These transaction costs, however, are likely to be higher when an acquirer has to overcome a defensive tactics barrier than when it doesn’t. Because searching acquirers ultimately bear transaction costs, search costs are higher in a strong defensive tactics regime than the simulations allow. Second, the ratio of targets to acquirers in our simulations is relatively high and the ratio of noise firms to acquirers is relatively low. Thus, the simulations likely overstate the probabilities with which acquirers make matches. Third, for convenience we assume mismanaged targets and synergy targets choose similar defensive tactics levels. Conventional wisdom holds that financial targets are more willing to sell themselves than synergy targets; hence, synergy targets may choose higher defensive tactics levels than financial targets. There is no data relevant to this conjecture, but we note here that permitting differential defensive tactics levels would reduce our market efficiency result by reducing the synergy buyer’s gain from search.
3. Shareholder Welfare

3.1 The Target’s Choice of Defensive Tactics

Defensive tactics are authorized by the board of directors in response to management recommendations. 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. 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 actually is beneficial to target shareholders has been difficult to answer rigorously for two reasons. First, the effect of defensive tactics on search intensity is difficult to measure, but search intensity is relevant to the question. Second, it is difficult to assess with precision the effectiveness of different defensive tactics and so their social and private welfare effects. Though the intellectual case is unclear, the Delaware courts – the courts that largely 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. In this Part, we initially consider how to compare different

---

49 Some defensive tactics, most importantly poison pills, can be authorized and deployed by the board alone. Other defensive tactics, like a staggered board or 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. The adoption of a staggered board is an exception – shareholder approval later ties shareholders’ hands. Also, eliminating a staggered board requires a charter amendment and so requires the board to initiate the process.

50 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. Once the corporation is in play, the board’s obligation is to maximize shareholder value.

51 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
defensive tactics. Then we test the results, using simulations, to derive the privately optimal
defensive tactics level as a function of the surplus that the tactics permit targets to realize.

The key to comparing defensive tactics is that different tactics have different effects on
target bargaining power. Two factors affect bargaining power: disagreement points and
discount rates. It is difficult for parties to an acquisition negotiation to affect their partner’s
disagreement point. The more patient party to a negotiation, however, is advantaged because
it can wait longer for better offers. Hence, defensive tactics exploit the second factor;
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. Thus, 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 and irreversible expected value declines could preclude offers altogether. Further, the
likelihood of additional bidder entry increases as the time between an initial offer and the
closing increases. Auction prices increase in the number of bidders so the possibility of entry
reduces acquirer expected gains. 52 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 and so is
particularly sensitive to the possibility of competing bids. To summarize, time is the common
metric along which to assess the efficacy of defensive tactics. 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.

though the record reflects that no bidder had ever continued its offer for two successive proxy fights. See Air Gas
supra note 4.
52 Heron and Lie (2015) at 287 find that “poison pills induce greater final takeover premiums, mostly as a result of
bid increases after the initial bid.”
The expected value of an acquisition to a target also is a function of bid probabilities. Regarding these, targets choose defensive tactics levels before acquirers begin to search (because targets can adopt poison pills quickly, acquirers will assume that every target is poison pill protected). Thus, as developed in Part 2, 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. A loyal board’s problem, then, is to solve for the defensive tactics level that best trades off the probability of receiving a bid – which implies weak defenses -- against the price conditional on a bid being made – which implies strong defenses.  

The target board thus should maximize a function such as

\[ \max_d E(R) = \pi((1-\lambda)s) - c(d) \]

where \(d\) is the target’s defensive tactics level, \(R\) is bid revenue, \(\pi\) is the bid probability, \((1-\lambda)\) is the target’s expected share of the acquisition surplus\(^53\), which is \(s\), and \(c(d)\) is the cost of implementing defenses.\(^55\) The bid probability is a decreasing function of the target’s surplus share while the target’s share is an increasing function of the defensive tactic level \(d\). We argue that there is an interior solution to the board’s problem. To enact no defensive tactics would cause \(\lambda\) to approach 1: most of the deal’s surplus would go to the acquirer. This would make

\(^{53}\) Karpoff, et. al (2015) at 4-5 is consistent with this analysis: “...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. For supporting views, “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, by about 4.5% over five years, that the firm will receive a bid. Also, 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). Many of the models that find negative correlations between corporate governance indices and firm value, however, may suffer from serious endogeneity problems. A recent study that confronts this concern persuasively argues that managerial entrenchment, which defensive tactics facilitate, materially reduces firm value. See Chang and Zhang (2015).

\(^{54}\) Recall that \(\lambda\) is the acquirer’s surplus share and equals \(\frac{\beta}{\beta-\sigma}\).

\(^{55}\) The cost of choosing a defensive tactics level includes legal and investment banker fees for advice and the cost, where applicable, of soliciting shareholder approval.
the revenue function negative. On the other hand, choosing a very high defensive tactics level would cause \( \lambda \) to approach zero; the acquirer would get no surplus. This would cause the bid probability to approach zero as well; and the maximization function again would be negative. At the two corners, therefore, the target would bear the costs of enacting defensive tactics but realize no gains. Hence, the *privately optimal defensive tactics level* for a firm that does not rule out acquisitions altogether will permit the acquirer to realize a material gain: \( \lambda \), that is, should be bounded strictly away from zero. We test this result by using a continuity argument: because the target’s expected payoff increases as \( \lambda \) falls, until \( \lambda \) falls so far as materially to reduce bids, the target’s return function should be strictly concave.

Our simulations support this prediction. We solved for the optimal acquirer search intensity under each of ten surplus splits: from .1 going to the target to 1. We then calculated the targets’ expected return under each split, given that acquirers were searching optimally against that split. Figure 1 summarizes the results. In the Figure, the horizontal axis plots the target’s share of the surplus with increasing values for \((1 - \lambda)\); the vertical axis plots the target’s payoff.

*Figure 1*
The lowest curve, TM, is the return to passive synergy targets who will match with a synergy acquirer; the second curve, TA, is the return to 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 curve, TP, is the return to 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.\(^5\)

The return function is concave, as the analysis predicts, and is maximized at a target surplus share slightly above .6. The left-hand skew is consistent with the sequential search model. 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 these assumptions, an acquirer’s net return from search should turn negative

\(^5\) Appendix 2 contains the relevant tables from which Figure 1 is derived.
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 3 and 4 exhibit 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 level than there should be when the target’s share increases by .1 to its maximizing level. Because a target’s expected return is a function of acquirer search intensity, and because acquirer search intensity is a function of the acquirer’s share, a target’s return thus should decrease more rapidly as the target’s surplus share goes beyond the maximum, when convex costs seriously bite, than the return should increase as the target’s share goes toward the maximum, when costs are increasing at a lower rate. This reasoning suggests that the target’s expected return, as a function of the defensive tactics level it chose, should be concave with a left hand skew; and this is what the simulations show.57

3.2 Social Welfare, Shareholder Welfare and the Delaware Courts

Turning to what this result 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 the evidence indicates obtains in the defensive-tactics-friendly legal regime. The simulations thus suggest that many current boards are at least roughly loyal to shareholders as regards defensive tactics: that is, boards are choosing defensive tactics levels that are not much higher than the levels that would maximize a target’s expected acquisition return.58 The corporate governance implication of the result that the privately optimal solution to the target’s problem is interior is that target boards should have significant, though not complete, discretion to choose defensive tactics levels.59

57 Cunat, et al (2015) shows that a vote to eliminate an anti-takeover provision increases bid premia. This is an unusual result, but it is partly consistent with our result. A firm whose defensive tactics level puts its expected return to the right of the maximum in Figure 1 would increase its expected return by lowering that level (i.e., moving to the left).
58 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).
59 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
It is a live question, however, 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 low-sixties privately optimal target share. This possibility is a cause for concern if target expected returns fall off as sharply when targets choose excessive defensive tactics levels in the real world as they do 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 – \((1 - \lambda)\) in the analysis above – is in the low 60 percent range. As Part 2 shows, such surplus shares yield a socially suboptimal level of matches. The 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 average defensive tactics level in the market, a loyal target board would ignore the search dampening effect of its choice. 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.

A countervailing analysis, called the bonding or short time horizon theory, takes two forms. First, the combination of a claim that the stock market excessively 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 the company. These agents commonly are partly compensated with stock, but stock would be an inadequate reward if the future value of those investments is not fully reflected in the target’s current price (and if the number of shares given is not adjusted to reflect that myopia), and the target’s shareholders are willing to accept a hostile offer. Because managers and

---

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.
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 is able to 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.

Also, customers and suppliers may make relationship specific investments with a potential target. An acquirer, who has no particular loyalty to these stakeholders, may exploit the sunk cost aspect of the investments by renegotiating the target’s deals with them. See 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. Does the efficiency loss from market myopia, which is largely unmeasured, exceed the large efficiency loss that, our simulations suggest, exists in consequence 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. The open issue is the elasticity of the executive’s investment behavior to her expected

---

60 The empirical claim that the stock market is myopic, on which this argument is based, is contested. Roe (2013) surveys the empirical and legal literature concerning short-termism.
61 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 shareholder approval may inefficiently reduce shareholder value. This suggestion preceded the wide adoption of poison pills. Cremers and Sepe (2016) and Cremers, et al, (2015) support Gilson’s conjecture with recent data.
62 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
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 a target 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 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 decisions whether to approve a pre-bid defensive tactic and to tender at the price offered in a hostile takeover are largely made by institutional investors, who today hold on average 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.

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 successors as well. A contract seems more secure than a reputational sanction. 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.63 Finally, this version of the bonding theory lacks significant empirical support. Nevertheless, our contribution is on the other side of the ledger: we suggest that defensive tactics alone can materially 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 longstanding 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.\footnote{Delaware takeover law has not concerned itself with what rule maximize social welfare.} Our model and simulations shed light on this still live 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 should 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 higher bids or to explain to its shareholders why the target’s market price understates the target’s real value. Once the target’s board had that opportunity, however, the shareholders had to be allowed to decide whether to accept the offer.\footnote{Capital City Associates v. Interco Inc., 551 A.2d 1140 (Del. Ch. 1988).} 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 challenge that in practice apparently no bidder has undertaken.\footnote{Airgas, supra note 4.} 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, if private efficiency is the relevant welfare measure the Chancery Court was correct in giving the board the time to increase the premium received by the target shareholders, but also correct in constraining the length of that delay. The Chancery Court’s informal analysis and our simulations thus 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 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. Decision makers in these institutions commonly ask whether a target board has fulfilled its fiduciary duty to maximize the welfare of a target company’s shareholders. In turn, much of the legal literature asks whether the fiduciary question is being answered correctly. Participants in this debate thus assess governance techniques by how they affect target shareholder interests. The less obvious reason why debate has focused on target shareholder welfare is that the social welfare consequences of defensive tactics are difficult to assess without analyzing the effect these tactics have on how acquirers, and targets, search for matches: that is, ex ante efficient acquisitions.

As it happens, both social and private welfare turn on how market agents search for matches. A legal defensive tactics regime maximizes social welfare when it helps agents make the maximum number of matches in a period compared to the number of matches that could have been made then. Theory thus holds that efficiency is best realized by allocating the surplus from matches to searchers: this would maximize agents’ search intensity, and thus the number of made matches. Theory is indeterminate regarding the best surplus allocation, however, when both potential buyers and sellers search because then both sides should be encouraged. Here, some potential targets search. Also, each potential target is to some extent unique; hence, even in a free corporate control market targets have the power to command some surplus. Thus, a deeper look at theory suggests that the social welfare effect of defensive tactics is best measured empirically. Regarding private welfare, loyal boards of targets free to choose will implement defensive tactics levels that maximize the targets’ expected gains from acquisitions, but the boards will not consider the search dampening effect these choices have on acquirer behavior. Therefore, the privately optimal level of defensive tactics should be
higher than the socially optimal level. The policy issue runs to the magnitude of this externality, which again is an empirical question.

Neither empirical question can be answered with conventional empirical techniques. This is because the empirical researcher cannot observe unmade matches. Hence, she cannot observe how a legal regime affects the ratio of made matches to total possible matches – which is relevant to the social welfare question – nor can she observe how the regime affects the probability that a target will receive a bid – which is relevant to the private welfare question. This paper addresses the empirical issues that both welfare questions raise by estimating search behavior in a simulated market for corporate control under two defensive tactics legal regimes: a regime in which defensive tactics are largely ineffective 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 yield two significant results. Regarding social welfare, the market makes almost 25% fewer matches – acquisitions – when potential targets are permitted to choose defensive tactics levels than when not. Though there are good reasons to believe that this result is artificially high, even halving it yields an economically important result in a market, such as the market for corporate control, where the value of transactions is now over a trillion dollars a year.

Regarding private welfare, in our simulations, target welfare is maximized when targets choose defensive tactics levels that imply their realizing a little over 60% of expected acquisition surplus. The sparse real world data suggests that actual targets choose defensive tactics levels to realize a little over 65% of expected surplus. This surplus split, as just said, yields many fewer than the optimal number of matches. Hence, though many actual target boards are (approximately) loyal fiduciaries as regards defensive tactics, the search externality their choices produce is large. In addition, the leeway the Delaware courts now give to boards suggests that some target boards are choosing defensive tactics levels that would permit their companies to realize more than the privately optimal mid-sixties surplus splits. To the extent these boards exploit the power current Delaware law gives them, both private and social efficiency are worsened.
Our results have substantive and methodological implications. Substantively, the results suggest that current legal rules allow 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 measuring the effect of defensive tactics in a market framework in addition to studying their effect on the profitability of particular companies.
References


Roe, Mark. 2013. “Corporate Short-Termism in the Boardroom and in the Courtroom”, 68 Business Lawyer 977.


Appendix 1

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 specifying a population size (in our case, 600 total risk neutral agent-firms) with agent-firms of one of six specified types. There are 268 total A (Acquiring) agent-firms in the simulated population. These firms are actively seeking to match with a target firm. Of these 268 A agent-firms, 128 are synergy (AS) type acquiring firms, and 140 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 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 willing to match with AS type firms, if approached (TM type target agent-firms). There are 16 TA type active, synergy target agent-firms, and 16 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 35 TP type passive, mismanaged, target agent-firms. AH type acquiring firms only seek to match with TP type target firms. Thus, there are 67 total T type target agent-firms: 35 TP firms, 16 TA firms, and 16 TM firms. Additionally, there are 265 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 600 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 and searching, active, synergy target (TA) agent-firms make up to twenty-two searches. There are 1000 simulation runs of each total search. A total search is defined as the point at which each acquiring agent-firm and each searching, active, synergy target (TA) agent-firm has had an opportunity to complete a search of a specified number of agent-firms (this is their “search intensity”). First, all of the searching agent-firms search a single agent-firm, then two agent-firms, then three, and so on, until completing a total search, which is defined as the point at which all of the searching agent-firms have had an opportunity to complete a search of twenty-two agent-firms. Thus, the population matrix is repopulated 1000 times for each total search.

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 TM firms, AH firms search for TP 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 for the acquiring agent-firms. Illustrating the latter possibility, let a potential acquirer realize positive expected utility at its third search, but the acquirer would realize negative expected utility from a fourth search. Then the model has this acquirer either matching as a consequence of one of its first three searches, or exiting after fruitlessly searching three possible targets. It is the expected utility of the acquiring agent-firms (the AS and AH agent-firms) that dictates whether search occurs and what an agent’s search intensity is.

To be clear, we determine the point at which the acquiring agent-firms cease searching is by having all of the searching agent-firms conduct a total search at each level of search intensity (over 1 agent-firm, over 2 agent-firms, . . . , over 22 agent-firms) for a 1000 simulation runs. If the expected utility for an acquiring agent-firm is positive when it searches over three agent-firms, but negative when it searches over four agent-firms, then this acquiring agent-firm stops searching after it has searched over three agent-firms.

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 searching agents incur search costs.

---

67 Restricting searches to twenty-two is without loss of generality because, in the simulations, it is never optimal for an acquirer to take more than twenty-one draws.
A simulation run unfolds as follows: The code iterates through the entire population matrix of 600 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 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, an acquiring synergy searching -- firm. The code searches for a match for this firm. To begin a search over 1, 2, ... 22 agent-firms, 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 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. Searching acquirers (AS and AH type agent-firms) do not search other searching acquirers, however. And, searching, active, synergy target (TA) type agent-firms do not search passive, hedge fund target (TP) agent-firms. (If an AS or AH type agent-firm comes across another AS or AH type agent-firm, the simulation randomly
chooses a new search sample of whichever search intensity (number of draws) and resumes the search at the same point at which the AS or AH agent-firm came across another acquiring type agent-firm. The same procedure is followed when a TA type agent-firm comes across a TP type agent-firm whilst in the midst of a search.) 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 a TP type firm on behalf of the AS searcher, and the other firm is the first firm to be searched. Upon recognizing the type of current firm being searched, 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 a firm with whom 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 the number of draws (number of agent-firms searched) as follows:

\[
\text{Search costs} = -2 - \frac{(\text{draw number})^2}{10} + .01
\]

Thus, the search cost for searching one agent-firm is -2 utils; the search cost imposed for searching a second agent is -2.03 utils, and so on. Search becomes costlier as the search continues. 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 a TP type firm. The line of code appears as follows:

\[
\text{popFitness}(i) = \text{popFitness}(i) + \text{cc};
\]

where cc is the variable for search costs for the possible number of agent-firms 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 a P type agent-firm, the code
uses same process for imposing costs. 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 will 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:

\[ \text{popFitness}(i) = \text{popFitness}(i) + B + cc \]

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 equally between the A (acquiring) type agent-firm and the T (target) type agent-firm. (Various splits of the surplus are possible. The code calculates asymmetric splits, that favor either A or T agents, in order to approximate the markets that result from legal regimes that are either friendly or unfriendly to defensive tactics). 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 \( 100 \times (1/2) \). 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:

\[ \text{popFitness}(jj) = \text{popFitness}(jj) + E \]

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, in this example, is split equally between the A (acquiring) agent-firm and the T (target) agent-firm, \( E \) also equals 100 utils \( \times (1/2) \). 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 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:

\[
\begin{align*}
\text{popFitness}(i) &= \text{popFitness}(i) + B + cc; \\
\text{popFitness}(jj) &= \text{popFitness}(jj) + E; \\
\text{popMatch}(jj,1) &= 1; \\
\text{popMatch}(i,1) &= 1; \\
\text{popMatch}(i,2) &= jj; \\
\text{popMatch}(jj,2) &= i;
\end{align*}
\]

In the example discussed above, a successful match was made, but agents may fail to match. Even so, each agent-firm member within the two draw search intensity of the example 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.

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 relevant 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 search intensity level.
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 agents (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 (search intensity level). 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.
In the order the tables are set out, the target realizes .3, .4 and .5 of the surplus. As is apparent, the target’s expected return is lower in the .3 and .5 splits, and is highest (and
maximized) in the .4 split. Figure 1 in text is represented continuously because it connects all of the splits. This is why a target’s expected return peaks at a little over a 60% share.