Short-Termism and Long-Termism*

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Abstract

A significant debate in corporate law and finance concerns the role of activist investors (especially hedge funds) in corporate governance. Activists, it is often alleged, imprudently privilege short term earnings over superior (but less liquid) long term investments. Activists counter that they target managers who unjustifiably cling to questionable strategies. While this debate is hardly new, it has grown increasingly fractious of late. We analyze the activism debate within a theoretical securities-market setting. In our framework — which draws from an emerging literature in empirical and experimental finance — managers are differentially overconfident (causing them to favor long-term projects), while investors are differentially present-biased (causing them to favor short-term liquidity). We allow these biases to be either fundamental or induced by institutional factors, and they can occur either in isolation or in conjunction. Equilibrium behavior bears an uncanny resemblance to the ongoing activism debate, providing a new perspective on well-worn battle lines. Prescriptively, we demonstrate that short-termism and long-termism can have symbiotic attributes. Consequently, an "optimal" corporate law and governance regime should account for both effects, as well their possible interaction.

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"You can cut all the flowers, but you cannot keep spring from coming."

Pablo Neruda

1 Introduction

A committed socialist, Neruda could hardly have foreseen how prophetic his observation would become in the inner sanctum of Western capitalism: the corporate boardroom. The inexorable arrival of spring portends shareholder proxy season for most U.S. public companies – a signal opportunity for shareholders to provide feedback and criticism to corporate fiduciaries through a variety of shareholder proposals, bylaw amendments, executive compensation approvals, and other governance matters.

But above all else, proxy season heralds the annual rite of director elections—a key outlet for investor irritation and (in the post-hostile takeover era) outright electoral challenges. The 2015 proxy season proved particularly riveting, featuring a pitched proxy prizefight over control of an American corporate icon: The DuPont E I Nemours & Co. ("DuPont"). Over the course of many months, the Trian Fund — an activist hedge fund run by financier Nelson Peltz — had amassed a sizable minority block of DuPont shares, clamoring with growing insistence for governance reforms, strategic changes, capital restructuring and board representation. By early 2015, having enjoyed limited influence through lobbying efforts, Trian launched a no-holds-barred proxy battle to win the four board seats up for election.

Among proxy fights, three aspects of the DuPont-Trian battle stand out. First, as noted above, it involved a prominent, venerable, and newsworthy US company with a storied pedigree. Second, unlike typical proxy targets (at least historically), DuPont was not some démodé dinosaur teetering on the brink; it appeared healthy and growing. Its share value had climbed an impressive 266% between 2009 and early 2015, far outdistancing the S&P 500 over the same time period (165%).

Third, the rhetorical battle for DuPont was couched in notably apocalyptic terms. Trian alleged that the DuPont board was too coddled, insulated, and unrealistically smitten with long-term investments of questionable merit; for their part, incumbent board members invoked the rhetoric of slash-and-burn "short termism" by Trian and other activist hedge funds. A statement from one of the incumbent board's defenders is characteristic:

> The playbook for many of these activists is to cut research, throttle back on new businesses, eliminate thousands of jobs, and leverage the balance sheet. These actions almost always improve the financial numbers in the next reporting period, but they weaken the long-term earning power of the company. Worse, they put the entire enterprise at risk when unpredicted events occur, such as the next economic downturn.[1]

During the first half 2015, both the DuPont incumbents and Trian challengers became able masters of social media, press releases, and lobbying tactics to curry favor among voting shareholders of all stripes. Trian was able to win the public endorsement of significant proxy advisory firms (such as Glass-Lewis and ISS), while DuPont secured support of significant institutional investors (such as CALPERS). When the dust finally settled, the incumbents had eked out victories on all four challenged seats. But the margin was uncomfortably small, with the split largely separating self-identified "long term" investors (including index funds such as Vanguard, BlackRock and State Street) from "short term" investors (which included both activist hedge funds and a sizable portion of retail investors – estimated to control around thirty percent of the shares).[2]

The governance kerfuffle at DuPont, and the rhetorical fisticuffs it precipitated, helps motivate this paper: Indeed, while DuPont is a compelling case study in its own right, it is also emblematic of a growing recent trend of shareholder activism[3]—one that has attracted an increasingly perfervid debate within the corporate law and finance community around contemporary

[1] Bill George, "The DuPont Proxy Contest Is a Battle for the Soul of American Capitalism," Huffington Post (May 11, 2015) (available at http://www.huffingtonpost.com/bill-george/the-dupont-proxy-contest_b_7256490.html)

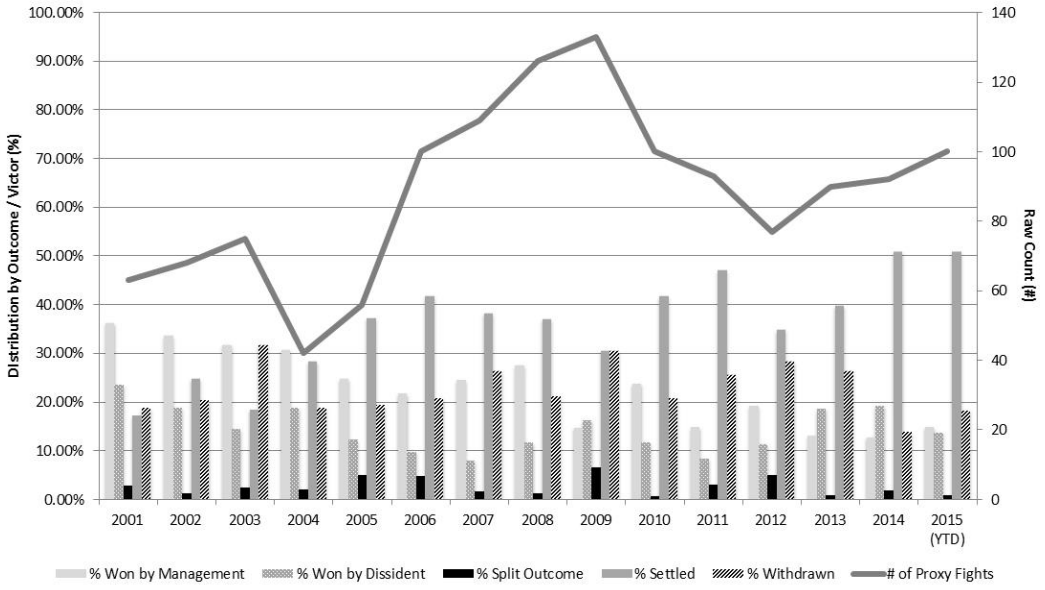
[2] Moreover, the victory proved pyrrhic for DuPont's management team. By the fall of 2015, less than a half year after the incumbents' electoral triumph, CEO Ellen Kullman resigned amid disappointing earnings announcements. We return to this coda below.

[3] Although there is no universal definition of shareholder activism, most functional definitions explicitly or implicitly view it as combining (a) the proactive and strategic use of a public company's corporate governance system; (b) by a single shareholder and/or coordinated group; (c) who has typically purchased equity with this activity in mind; (d) and who seeks to have influence over corporate affairs and decision making. While the motivations of activists can of course be far reaching, for purposes of this paper we focus on activists who hope to use strateges (a) through (d) as part of a profit-motivated investment strategy – so-called "economic" activists (which includes most activist hedge funds).

activism's merits.

There is little doubt that activism has become a force to be reckoned with among U.S. issuers. The last fifteen years bear witness to a discernible escalation of proxy fights similar to DuPont's (see Figure 1). Moreover, even as the number of proxy challengers has escalated, they have enjoyed greater success: dissidents now gain some measure of victory (through settlement or outright victory) in over two-thirds of the challenges they launch. The burgeoning success of proxy fights is arguably reflected in the contemporaneous growth of activist hedge funds, which have ballooned from under $100 million in assets under management in 2000 to over $140 billion today (HFR 2014). In short, activism pays.[4]

Figure 1:
Proxy Challenge Incidence and Outcome among US Issuers, 2001-2015
Right Axis/Line: Incidence; Left Axis/Clustered Bars: % Outcome
Source: FactSet (2015 figures omit all pending proxy contests as of October 15, 2015)



While the activism trend is remarkable, the cacophonous debate sur-

[4]It bears noting that Figure 1 almost certainly understates the effects of activism: proxy fights are but the "nuclear end game" of activist engagements, and many activists exert influence (including procuring board representation) without ever launching a proxy fight. These other levers of influence – while difficult to observe directly – can be measured (in part) with other proxies, such as Schedule 13D filings, shareholder proposals, and public "bear hug" letters from activists to boards.

rounding it *really* steals the show. The competing positions are by now well trodden terrain.[5] Activists, it is alleged, privilege short term earnings over more durable (but less liquid) investments in long term value, leading to business decisions that not only forsake long term value for immediate gain, but do so in a manner that sacrifices net present value. (See, e.g., Lipton 2013). And indeed, several studies of hedge-fund engagements find that hedge fund activism significantly curbs long-term investments in research and development, durable assets, and workforce capital (Coffee & Palia 2014; Allaire, & Dauphin 2015). The compensation structures of hedge fund managers appear, moreover, to be especially skewed towards short-term payoffs (Lim et al. 2015). In addition, the practice of extracting "hushmail" (a descendant of 1980s-style greenmail) has gained traction of late, whereby an activist takes an ownership block in an issuer and agitates for capital disbursements, only to settle with the issuer by selling back its stake at prevailing prices (Gerstein et al. 2014).[6] Moreover, the effect of activism need not be limited only to those firms personally experiencing activist engagements: boards of other issuers may well be affected too, fearing that their own governance structures leave them vulnerable, and thus capitulating *sua sponte* to anticipated activist demands. That short-termists have had such wider and significant effects — it is often argued — bodes poorly for future stability and growth, within both individual companies and the broader US economy (Conference Board 2015).

Activists, in contrast, openly and vigorously contest the charge of "short-termism," asserting it is little more than bluster eclipsing substance. They cite several empirical studies that suggest activists bolster shareholder value. Most notably, announcements of activist engagements are usually followed by positive and significant abnormal returns (Bebchuk et al. 2014; Boyson &

[5] Indeed, traces of this same debate go back decades. See, e.g., Porter (1992).

[6] See, e.g, Greenwood & Schor (2009) (positive returns associated with activist engagements are largely concentrated among firms that are eventually acquired). While not categorically objectionable, hushmail can represent a net wealth transfer from other shareholders if the activist's intervention itself gives rise to an episodic asset bubble. As with greenmail, however, Delaware courts have shown little willingness to scrutinize such practices, granting them significant protection under the Business Judgment Rule. See, e.g., Ryan v. Gersahaney (C.A. # 9992-VCP; Del. Ch., April 2015) (dismissing a derivative action challenging a hushmail transaction between ADT Corp. and Corvex Management, LP, an activist hedge fund). Moreover, the repurchase of an activist's shares at prevailing market prices appears to sidestep both federal tax penalties and state law prohibitions on the payment of green mail (Gernstein et al 2014).

Mooradian 2010; Brav et al. 2008, 2013, 2015; Clifford 2008; Greenwood & Schor 2009; Klein & Zur 2009). And, while some of these price increases inure to activists alone, other shareholders and investors appear to benefit too (Bebchuk et al. 2013). Further, defenders argue, activist engagements do not obviously trade short-term gains for long term ill: companies that experience an activist engagement have been found to experience long term performance similar to non-engaged firms (albeit amid some statistical noise; Bebchuk et al. 2015). Viewed from this perspective, the lambasting of short-termism is but a grandstanding apologia for managerial entrenchment. Fetishizing the long term for long-termism's sake, activists assert — irrespective of concrete company benefits — warrants neither our collective sympathy nor the protective cloak of the Business Judgment Rule.[7]

It is hardly novel to observe that participants in this debate have long been talking past one another (Coffee & Palia 2014). In our view, at least part of the debate's dysfunction stems from a failure of many participants to attend to fundamental questions about market structure and human behavior to moor their positions. Critics of activism, for example, have struggled to articulate the reasons behind the short-termist frenzy they perceive to imperil responsible stewardship (Roe 2015). Why, for example, wouldn't more patient, long-horizon investors have strong incentives to neutralize short-termism by retaining their shares (and even increasing their holdings) whenever long-term projects have greater overall value? Moreover, even investors with short time horizons must find a ready market to unwind their positions upon exit. It is not obvious that they will support investment choices that generate cash flows in the near term while undercutting residual value. If the short-termism criticism is to have legs, then, it must be because of a market failure that distorts price discovery during activist engagements—an account that seems absent (or at least suppressed) in their rhetoric.

Defenders of activism, too, have failed to situate several of their central claims convincingly. To the extent that activists play a role in creating asset "bubbles" in targeted companies, for example, immediate abnormal returns upon an activist engagement signal little more than ephemeral,

[7]Delaware courts, by and large, have thus far extended something akin to Business Judgment Rule protection for anti-activist defenses. See, e.g., Third Point LLC v. Sotheby's, C.A. No. 9469-VCP (Del. Chancery Ct. May 2014) (using the deferential Unocal standard to uphold a poison pill of defendant corporation triggered by a 10% block of shares amassed by an activist, but a 20% block of shares amassed by "passive" investors).

wealth-transferring price volatility (Greenwood & Schor 2009). Moreover, comparing long term performance of engaged to non-engaged issuers holds limited probative value if the prospective threat of activism induces boards of *non-engaged companies* to adopt the same activist-favored tactics as their counterparts (as many have long decried – Lipton 2013).[8] Even the notion of agency costs / empire building – the standard canonical assertion that animates much of the activist positivist critique of boards – may have limited explanatory force when juxtaposed to the last fifteen years' worth of post-Sarbanes Oxley / Dodd-Frank regulatory scrutiny, which has if anything *dampened* the private benefits of control thought traditionally to motivate fiduciaries (Talley 2015).[9] Activist advocates also face difficulties in reconciling their position with another recent trend among U.S. public offerings: the rapid rise in entrenched governance structures (such as dual-class stock), whereby founders and initial insiders retain super-majority control of a public company. Such structures are at an all-time high among technology IPOs, representing just under a third (by value) of the sector's recent deal volume (Braithwaite 2015). The growing popularity of entrenched governance structures at the financially critical IPO stage – often to preempt future activism – challenges the proposition that today's brand of activist engagement augurs unalloyed company value.[10]

Finally, a remarkable aspect of the activism debate from both sides is its increasingly uncompromising tone (even among typically even-tempered academics). Advocates from both camps have grown sharper and more impassioned in advancing their claims, seemingly convinced of the utter ineluctability of their positions. While some of this rhetoric is no doubt performative, much of it has (in our view) deeper roots: The activism debate

[8] In other words, if activism distorts corporate behavior "off the equilibrium path," then an observed long-term statistical similarity of engaged and non-engaged firms is both unremarkable and uninformative.

[9] And in any event, today's activists appear not to have disabled managers from retaining their positions (or even altering executive compensation structures), so long as such managers are willing rebalance the firm's capital structure and investment portfolio in a manner favored by activist investors. See note __ infra.

[10] Although companies that are already listed seemingly do not have recourse to dual class structures, even that observation overstates the case. Listed companies buffeted by activist pressures may well be able to turn to the private equity buyers, as did Dell with Silver Lake Management in 2013. And, in fact, the newly-private Dell has itself become a private-equity buyer, recently announcing a take-private deal for activist-beleagured EMC (and its held subsidiary VMWare). See McGurk et al. (2015).

is compelling reading, in part, because many of its most ardent participants appear to come by their positions honestly.

In this paper, we reassess the activism debate, offering a new theoretical account of managerial long termism and hedge-fund short termism. Our framework is inspired by two well-documented phenomena in corporate finance. First, mounting empirical evidence suggests that corporate managers are frequently susceptible to optimism bias regarding their selection and stewardship of projects (e.g., Malmendier & Tate 2005; 2008). By our reading of this literature, overconfidence seems most plausible in the context of long-term projects, where benchmarks are scarce, interim results recondite, and statistical noise significant. We refer to this skewed managerial infatuation with long-term projects as *long-termism.* Overconfidence-driven long-termism can cause corporate fiduciaries to be *too* invested in their own visions, and too quick to dismiss alternative (and shorter-term) proposals of shareholder activists. Long-termism might additionally explain why investment is sensitive to availability of internal funds (Malmendier & Tate 2005), and why founders would embrace relatively entrenching governance regimes at the IPO stage, in order to secure (sensibly, in their view) breathing room to realize their long-term vision.

Second, we draw inspiration from a growing literature suggesting that investors may be differentially susceptible to present-biases in trading off current and future payoffs. In some cases, these present biases may be the result of deep preferences (e.g., hyperbolic discounting a la Laibson 1997; O'Donoghue & Rabin 1999, 2001). In other instances, they may be induced by extraneous forces (such as hedge-fund compensation structures or clients' need for liquidity; Ben David et al. 2012; Lim et al. 2015). In either case, however, present biases can introduce a type of time inconsistency, which in turn may offer a reason why prices in financial markets can — in heat of the moment — overvalue business plans yielding immediate payoffs, even at the opportunity cost of foregoing more lucrative long term alternatives. In such settings, present-biased shareholders may place significant pressure on managers to abandon long-term strategies in favor of less profitable short-term payoffs, and asset prices may reflect those preferences.

Our model, therefore, explores corporate decision making in a securities-market setting among potentially biased players, designed specifically to explore how managerial optimism and investor short-termism plausibly interact. We allow for differentiated degrees of both managerial long-termism and investor short-termism; a governance structure whose degree of entrenchment

can be varied; a possibility for shareholders to use the governance regime to "revolt" against the manager's plan; and an initial IPO stage that prices securities sold to outside investors by a manager/founder.

Our framework yields several insights relevant to both the activism debate and to behavioral corporate governance more generally. From a theoretical perspective, the simultaneous interaction of two distinct biases among otherwise strategic players presents somewhat of a modelling challenge. Our analytic approach, in fact, requires that we posit an equilibrium concept that is (to our knowledge) new to the literature, characterizing the interactions of agents who exhibit some degree of naïveté about their own biases, yet are astute and strategic in their assessment of their counterparts.

More practically, our analysis yields several general insights about the shareholder activism debate—insights that not only have interpretive content, but also carry real-world implications and policy repercussions. Among them:

- Overconfident managers tend, in equilibrium, to be overly attracted to long-term projects *ex ante*, eschewing short-term alternatives that are more economically advantageous. Accordingly, equilibrium shareholder uprisings tend to target the *most* overconfident of managers who embrace long-term strategies (*see* Corollaries 2 and 4).

- Nevertheless, present biases can also induce *inefficient* shareholder uprisings, wherein managers are forced to jettison long-term projects even when continuation would be more efficient (Corollary 2). When extreme, equilibrium present biases can preclude the pursuit of long-term projects *categorically*—even those that are value-enhancing (Corollary 1).

- Even though unbiased investors disagree with their present-biased counterparts about corporate policy, they benefit from present-biased shareholders too: for such shareholders can introduce price discounts that allow unbiased shareholders to realize positive economic rents in equilibrium (Lemma 2).

- When equilibrium prices reflect investors' present biases, activist engagements can lead to pricing "bubbles" – upward shocks in the firm's market valuation that are the artifact of marginal investors' time-inconsistent preferences, rather than overall fundamentals (Corollary 3).

- Managers tend, in equilibrium, to favor governance regimes that appear entrenching (such as super-majority/unanimity voting rules). Such structures need not be value destroying, however, if they vest control in shareholders who are less likely to manifest short-termism (Lemma 5).

- The simultaneous presence of managerial overconfidence and investor present biases can be symbiotic, striking a balance between inefficient shareholder revolts *ex post,* and inefficient managerial project choices *ex ante*. Consequently, the normative implications for corporate law may be relatively modest when the two effects interact (Corollary 5).

- Because actors in our model perceive others' biases but not their own, in equilibrium they remain adamantly convinced of the righteousness of their own positions and dismissive of inconsistent views (a sentiment that patently pervades the ongoing debate over activism).

Several caveats to our analysis warrant attention before proceeding. First, because our focus here is on manifest preference biases (overconfidence and present bias), we will give necessarily shorter shrift to other factors in the activism debate that also carry significance. Most notably, although our analytic framework starts with a conventional managerial moral hazard model, agency costs will not play a focal role in our analysis. This is not meant to reflect our view that agency costs are completely irrelevant to the story; to the contrary, we believe such factors should and do play a material role in this debate on both sides, even in ways that intersect with behavioral biases (See, e.g., Bolton et al. 2006). Rather, we push agency costs slightly offstage principally to facilitate exposition of behavioral biases we also think important.[11]

[11] That said, as alluded to above, conventional agency cost arguments may not be as powerful here as one might think. A common agency cost argument for hedge funds activism, for example, asserts that incumbent managers seek to build empires, which facilitate greater private benefits (Bebchuk et al. 2014). Yet, evidence is not especially consistent with activism limiting empire building. As others have pointed out, if abnormal returns in response to activism announcements reflected decline in agency costs, one would expect activists to lobby for changes to executive compensation. Yet, the positive market response is not associated with these kinds of activism, but rather with changes to corporate investment and strategy (Coffee & Palia 2014). In addition, the idea that managers overinvest for personal gains, at the expense of shareholders and lower share value, is

Second, although we primarily highlight *behavioral biases* on both the investor side and the managerial side of a financial market, the framework we develop is amenable to a rational-actor framework too. Much of our analysis would still follow, for example, if biases were induced institutionally (e.g., through compensation structures) rather than an organic artifact of deep preferences. Moreover, we allow significant flexibility in how such biases are distributed among actors: Standard expected utility maximization (with no biases) is in fact a special case of our model, allowing us to analyze equilibrium behavior as one varies manifest bias on either side of the market (Camerer & Talley 2007). In a related vein, although our model commits – as it must – to particular drivers of short-termism (present bias) and long-termism (overconfidence), other types of behavioral bias could generate similar predictions. For example, a theory of salience (e.g., Bordalo, Gennaioli & Shleifer 2012) could also predict short-termism if shareholders are systematically attracted to projects whose expected returns are more readily estimated and quantified, as may plausibly be the case for short-term projects (c.f., Shefrin & Statman 1984). The predictions that such alternative approaches generate are likely to overlap considerably with those we generate here.[12]

Finally, preference biases tend to magnify a pre-existing challenge about the normative content of corporate law: What, exactly, is corporate law supposed to "maximize" to begin with? This question is difficult enough to answer in the rational actor framework, where shareholder primacy routinely butts heads with other potential normative maximands that include non-shareholder constituencies (such as creditors, employees, customers and managers themselves). In settings where shareholder and manager preferences may be inconsistent over time or by context, the normative challenge is redoubled. To the extent that we are interested in such normative questions, however,[13] we must specify a benchmark welfare measure. In what follows,

not considered that convincing anymore. Compensation structures have changed, so that managers do not benefit that easily from inefficient purchases (Id.) Managers plausibly care about their reputation, trajectory, and in general are high achievers who are willing to work hard to meet their goals (rather then perquisite consumption).

[12]Such predictive overlap is comforting, of course, but it could also be troubling to the extent that the prescriptive policy response turns critically on understanding exact nature of the bias at issue. We discuss this at greater length at the end of the paper.

[13]Most of our analysis is neutral about welfare implications. Only at the end do we address these larger normative questions.

we will identify an "optimal" corporate governance structure to be the one that maximizes the expected enterprise value of the firm (the sum of expected shareholder and manager payoffs), evaluated in the absence of either investor present bias or managerial overconfidence. Consequently, while a biased investor or manager may *perceive* herself as favoring one choice over another, our normative frame will assess and evaluate that same choice from the perspective of an actor harboring no preference biases (induced or organic).

Our analysis proceeds as follows. Section 2 reviews the large (and growing) empirical literature on managerial overconfidence and investor present biases. We show that this literature makes a convincing case that – at least in some settings – both phenomena are plausible, in isolation or conjunction. At the same time, the literature has shed relatively little light on the incidence (and implications) of the mutual interaction of these phenomena (particularly within the activism debate). Section 3 develops a simple theoretical framework that is adequate to the task. There we presume that both investors and corporate managers are prone to the biases described above, and we study the implications of such biases within a setting with active securities markets and corporate governance processes. We also propose an equilibrium concept for settings in which "naïve" boundedly rational agents nonetheless interact strategically with other such agents. We apply this concept to our structural framework to draw out various of the intuitions highlighted above and characterize our core equilibrium result (Proposition 1). Section 4 explores extensions to our modeling framework, divining both prescriptive and empirical implications of our key insights. Section 5 concludes.

2 Literature Review

As noted above, part of our enterprise in this paper is synthetic: we seek to analyze the activism debate by intersecting two distinct conceptual accounts from behavioral finance: managerial overconfidence and investor present bias. This approach is more challenging than it first appears (or at least than it first appeared to us): for our synthesis endeavors to bridge a nearly hermetic divide between two principal sub-literatures in behavioral finance: The first relaxes rationality assumptions for investors only, assuming managers to be unbiased and rational; the second strand does the opposite (Baker & Wur-

gler 2013; Malmendier & Tate 2012).[14] In many interesting applications, of course, behavioral biases may simultaneously occur in both places; and we consider this to be one of those applications.

Accordingly, we take some time here to offer a high-level review of the literature on both managerial overconfidence and investor present bias, and conditions under which either (or both) may pervade corporate governance settings within public companies.

2.1 Managerial Overconfidence

Managerial biases are now part of mainstream corporate finance. One particularly salient instantiation is managerial overconfidence, or "optimism," where robust literature documents the incidence of managerial overconfidence, including within corporate capital budgeting decisions. Less heralded in the literature is a sub-thesis we advance here: that overconfident managers tend to exhibit such biases most visibly with long-term projects. The alignment of overconfidence with long termism is natural, since long-term projects tend to be less liquid, harder to benchmark, and less transparent for outsiders (or sometimes even insiders) to evaluate.

2.1.1 Overconfidence Generally

Overconfidence is common, and it has been documented in numerous experimental settings. Most individuals rank themselves above average across different skills, and the likelihood for positive life events, and below average for the likelihood of different negative life events (Larwood & Whittaker 1977; Svenson 1981; Weinstein 1980). Senior corporate executives are not immune to such proclivities. If anything, they are more susceptible. Indeed, several studies report direct evidence for executives' overconfidence in particular (e.g., Ben David et al. 2013; Graham, Harvey, and Puri 2010; Larwood & Whittaker 1977). Perception of control over outcomes (Langer, 1975), commitment to the outcome (Weinstein, 1980), and strong skills (Kruger 1999; Camerer & Lovallo 1999)—all of which characterize CEO's relationship to their projects—are associated with high degrees of optimism. Furthermore,

[14] The nearly empty intersection between these sub-literatures (see Baker & Wurgler 2013) may be due – in part – to the absence of a ready equilibrium concept amenable to settings where both sides of a market potentially manifest biases. We will propose such an equilibrium concept below (see Section 3).

the low frequency of feedback CEOs receive given their position atop the organizational food chain, and the noisiness of feedback from the stock market, help reinforce and perpetuate overconfidence (Nisbett and Ross, 1980).

If managers are overly optimistic about their favored projects, that overconfidence likely affects their capital budgeting decisions too. They may, for example, draw too heavily on internal sources of funds; and—if they also believe the company shares to be undervalued—they may underinvest from external funds. As a result, overconfidence should lead to excessive sensitivity of investment to cash flows (Heaton 2002). Building on this intuition, Malmendier and Tate (2005a, 2005b) constructed two different measures for overconfidence, testing their metrics against the sensitivity of corporate investment to cash flow. The first, an option-based measure, measures management' tendency to hold options unexercised long after they have vested. Absent overconfidence, managers (whose human capital is not diversified) should exercise their options when they vest and liquidate them immediately (Sen & Tumarkin 2015). By failing to exercise (or exercising and holding), managers reveal their beliefs that the company shares are undervalued. The second, a press-based measure, focuses on public perception of managers as overconfident, based on news paper citations. Both measures are associated with high sensitivity of investment, measured by CAPEX, to cash flow returns (Malmendier and Tate 2005a, 2005b).[15]

A survey-based study similarly found unambiguous effects of managerial overconfidence in investment choices. Surveying public company CFOs on a quarterly basis over a ten-year period, Ben David et al. (2013) find that they typically underestimate the volatility of their companies' future financial performance. The results were significant: only in one-third of the cases the actual realized performance fell within the CFOs' predicted confidence interval. Moreover, total firm-level investment tended to be higher the greater the degree of overconfident miscalibration.

Overconfidence similarly appears to affect appetites for acquisitions. Malmendier and Tate (2008) find that overconfident managers are more likely to acquire other firms, and that their acquisitions tend to portend more extreme negative returns. In a similar vein, Banerjee et al. (2015) utilize the passage the Sarbanes Oxley Act (SOX) to test the hypothesis that board monitoring could limit excessive, overconfidence-driven investments. They find that

[15] Malmendier and Tate do not make welfare determinations, however: as they explain, whether managers overinvest or underinvest depends on their initial capital structure.

following SOX overconfident CEOs reduced total investment, as well as its sensitivity to cash flow and increased dividends. Tobin's Q and post acquisition performance both grew in firms with overconfident CEOs following the passage of SOX.

Other managerial behaviors – such as earnings management and financial reporting – appear similarly to interact in a consistent way with overconfidence measures (Schrand and Zechman 2010; Graham, Harvey & Puri 2010). And, both options-based and press-based measures for overconfidence were associated with a higher likelihood for firms to issue earnings forecasts, greater optimism in the forecasts issued, and a higher likelihood to miss those forecasts subsequently (Hribar & Yang 2015).

2.1.2 Overconfidence and Long Termism

Although somewhat overlooked in the literature, managers are more prone to overconfidence when it comes to *longer-term* projects. Beyond its intuitive appeal, this posited relationship between overconfidence and long-termism enjoys support in the experimental literature. Overconfidence has long been known to be significantly higher when uncertainty is large (Irwin 1953, Armor and Taylor 2002; Van den Steen 2004). Long-term projects tend to involve higher uncertainty along several dimensions, including the macroeconomic fluctuations, stock market performance, industry performance, and internal factors such as changes to managers' ability, personal factors, etc. While clear and immediate sanctions can mitigate overconfidence (Armor and Taylor 2002; Stocken's 2000), for long-term investments those sanctions are necessarily more distant and have noisier triggers.

Long-term investments also weaken potential learning from feedback, as they are associated with higher *attribution bias*—the tendency to take responsibility for success but not for failure (Langer & Roth, 1975). Over a long duration, managers would have greater opportunities to attribute failure to exogenous events. Experimental evidence lends support to the intuition that individuals' overconfidence increases along investment time horizon. Subjects who were asked to predict their performance in a number of tasks were significantly more optimistic well before the task than immediately prior to performing it (Gilovich & Medvec 1993). Similarly, college seniors' predictions about their first-year salaries became less optimistic as graduation approached. Juniors' and sophomores' optimism, in contrast, did not decline over the year, suggesting that the proximity to benchmarking

moments uniquely dampens optimism (Shepperd et al, 1996).

Among public company executives, moreover, the link between overconfidence and long-term horizons appears prevalent as well. Analyzing three- to five-year earnings growth forecasts among executives, Babmer et al. (2013) find that executives tend to be highly overoptimistic, significantly exceeding actual growth rates. The average long-term growth forecast predicted (15%) was five times larger than the average realized growth rate (3%). Indeed, there is even evidence that overconfident CEOs specifically bargain for more options-intensive compensation packages (Humphrey-Jenner et al. 2016), which overwhelmingly have multi-year vesting and expiration periods (Cadman et al. 2013).

Similarly, long-term overconfidence among executives appears to be more sustainable and resistant to feedback from long-term investment returns. Chen et al. (2015) find that overconfident CEO are less likely to respond to corrective feedback, and especially so for forecasts with a long-term horizon, possibly since the passage of time provides several pretexts for finger pointing. Specifically, Chen et al. (2015) study a sample of managers whose initial forecasts included material errors, finding that overconfident managers were less likely to improve their forecasts' accuracy over time. The results were especially strong for forecasts with long time horizons.

Finally, long-term investment horizons appear to amplify the effect that overconfidence exerts over capital budgeting decisions. CFOs that replied to the Ben David et al. (2013) survey were asked to make a short-term (one-year) and a long-term (ten-year) prediction. While corporate investment was positively correlated with both short-term and long-term overconfidence, the relationship was especially strong for long-term over-confidence: one standard deviation in miscalibration or optimism invests 0.7%, or 1.1% more each year, on a basis of 8.8% average investment intensity (Ben David et al. 2013).

If—as we conjecture here—managerial overconfidence is particularly concentrated in long-term investment projects, it would help to explain several phenomena in the activism debate. As Malmendier & Tate demonstrate, overconfidence could lead managers to invest excessively from internal funds, especially when the firm's internal funds are significant (Malmendier & Tate 2005a, 2005b). Since hedge funds activism frequently limits internal funds by forcing dividends distribution, share repurchases, and leverage increases (Coffee & Palia 2014), it also limits investments that are driven by over confidence and long-termism. Moreover, overconfidence as to long-term projects would

help to explain why hedge fund activism curbs one particular kind of capital budgeting activity: R&D investments (Allaire & Dauphin 2015; Coffee & Palia 2014). Given their long-term horizon and inherent uncertainty, R&D projects are especially prone to long-termism. And, overconfident managers tend to invest more in R&D, and achieve more patents and patent citations (Hirshleifer, Low, and Teoh 2010).

2.2 Investor Present Bias

On the investor side of the market, short termism is naturally linked to the sizable literature on investors' present bias. Market participants with present bias will tend to discount future income streams inconsistently, placing disproportionate weight on current income streams relative to future streams. The inconsistency occurs because individuals tend to strike different trade-offs between the same set of payoffs at different periods of time.

2.2.1 Present Bias Generally

Although the literature on present bias is rich and large, much of it emanated from a need to reconcile decision theory with experimental and empirical data. Among psychologists, the well-known Stanford "marshmallow experiments" (Mischel et al. 1972) provided a compelling early example present bias among young children.[16] However, a well-known experiment soon thereafter (Thaler 1981) documented significant inconsistencies in how adult subjects implicitly discount time payoffs associated with monetary rewards. Subjects asked to report their subjective present value of a fixed sum of money paid in the far distant future (10 years) and in the near distant future (one month). Subjects displayed extreme discounting for all future payoffs, with a disproportionate discontinuity for payoffs realized in the near distant future—suggesting a discounting "kink" beyond the current period. Moreover, present biases can induce evident preference inconsistencies over time, causing one's trade-off between two future payoffs to dampen (or even reverse) as the synchronous time for arrival of both options declines (Benabib et al. 2009). For example, individuals who prefer to receive $150 in eleven years over $100 in ten years tend to reverse that preference once the proposition becomes a choice between receiving $150 in *one* year versus $100 *today*.

[16] We will stipulate for current purposes the assertion that preschoolers have dispositions that are noncomparable to and distinct from high-powered hedge fund managers or CEOs.

(Green et al 1994; Kirby & Herrnstein 1995). Such preference inconsistencies appear in some ways to be biologically hard wired, and are not limited to humans (see, e.g., Ainslee & Herrnstein 1981, documenting the effect in animals).

2.2.2 Present Bias in Financial Markets

To be sure, several studies documenting present bias have focused on non-financial assets (marshmallows, movie videos, and other consumption items). By no means, however, are financial assets peripheral. Not only were several foundational studies of present bias based on financial claims (e.g., Thaler 1981, supra), but the bias has been detected robustly in a variety of financial market settings. Fredreick et al. (2003) review the significant literature on present bias, summarizing dozens of individual studies across a variety of experimental and topical domains. A strong plurality of experimental studies in the laboratory and field analyze time preferences over financial assets, typically with real stakes. (See Frederick et al. 2003, Table 1).

That said, one dimension of typical capital market intensity has been shown partially to blunt the occurrence of present bias: significant monetary stakes. In high-stakes settings, experimental evidence suggests that present biases attenuate—a phenomenon that researchers have identified as the magnitude effect. While an individual may, for example, favor \$10 today over \$11 in a week, the same person may decline the opportunity to receive \$10,000 today and choose wait for \$11,000 next week (Baker et al. 2003; Benhabib et al., 2010; Petry, 2001; Raineri & Rachlin, 1993; Thaler, 1981). That said, some form of present bias still typically can be found in such settings (even if attenuated). Moreover, it is important to keep in mind that when financial stakes grow large, even small perturbations in effective discount rates have significant monetary implications. Furthermore, recent research suggests that the magnitude effect appears to have less bite when contemplating losses as opposed to gains (and it may even reverse with losses, see Hardesty et al. 2012). If an investor views uses initial purchase price as a reference point defining gains or losses, then price fluctuations might also be characterized as both gains and losses. Under this interpretation, shorter-term investors (who have generally purchased shares more recently, and for whom neither gains nor losses are close to certain) are plausibly the *most* susceptible to present bias.

In a related vein, present bias can be sometimes induced through incen-

tives (rather than organic preferences). For example, compensation structures for hedge fund managers appear similarly to favor short term cash-flow generation, particularly among less established funds. Recent research by Lim et al (2015) analyzes the total compensation benefits to hedge fund managers for actions that increase asset values for shareholders today. They estimate that for every one dollar increase in investor wealth, hedge fund manager wealth increases by nearly forty cents, and far more for younger managers/funds with less established track records. Although this structure could be due to an induced quality signaling phenomenon (e.g., Holmstrom 1982; Stein 2005; Berk & Green 2004), the structure could induce behavior resembling time-inconsistent preference distortions, particularly if hedge fund managers have an option of pursuing short term returns at the expense of long term returns (Lim et al. 2015; Stein 1989). [17]

Other factors that may amplify both organic and induced present biases are structural constraints on investment strategy that serve functional as limits to arbitrage (Shliefer & Vishney 1990). A growing literature has highlighted several such factors that could limit hedge funds' arbitrage options. In addition to standard asymmetric information arguments, hedge-fund investors also have to make assessments with respect to the risk of redemption by other investors (Liu and Mello 2011). Ben David et al (2012) report evidence from the 2008 financial crisis consistent with hedge funds facing significant limits to arbitrage due to redemption risk. During the financial crisis, investors' redemptions and margin calls resulted in hedge funds selling off approximately a third of their portfolios' assets. Lockup periods not only failed to dampen the risk, but they were associated with larger redemptions. Evidence from the technology bubble also is consistent with hedge funds' limits to arbitrage: Rather than correcting prices, hedge funds appeared to be riding a technology bubble (Brunnermeier & Nagel 2004).

A substantial theoretical literature has emerged in the last two decades attempting to formalize how present-biased preferences may manifest in an

[17] Furthermore, present bias under circumstances may be rooted to rational processes. For example, if proximate payoffs are significantly more ceratin than all other future payoffs (as would be the case with dividends, repurchases and distributions from internal funds), risk aversed investors would rationally exhbit inconsistent discount for time (Sozou 1998). That said, when present biased behavior is induced by skewed compensation structures, limits to arbitrage or even risk aversion, the actors would similarly be sophisticated about their future preferences, but would have little interest in constraining their future choices. (See Section 4, infra).

behavioral economics choice setting. One of the most studied is the concept of "quasi-hyperbolic discounting" (Laibson 1997; O'Donoghue & Rabin 1999, 2001). The discrete-time representation of this account posits that individuals anticipating at time t a stream of future utility flows $U_t = \{u_t, u_{t+1}, u_{t+2}, ...\}$ will formulate a present value of that stream as follows:

$$PV\left(U_t|\beta,\delta\right) = u_t + \beta\delta u_{t+1} + \beta\delta^2 u_{t+2} + ... = u_t + \beta \cdot \sum_{i=1}^{\infty} \delta^t u_{t+i} \qquad (1)$$

where δ denotes a conventional exponential discount factor.[18] The factor β denotes an additional discount factor applied linearly to all future payoffs (but not the current one). When $\beta = 1$, the expression above converges to a standard present value formulation. However, when $\beta < 1$, the individual gives disproportionate weight to current utility over future utility flows. Moreover, as time passes, and each successive payoff transitions to the "present," the individual's preferences may manifest inconsistencies, resulting in preference reversals similar to those observed in laboratory settings.[19] Although there are several alternative candidates for representing present bias within a choice theory paradigm, the (so-called) "β-δ" model has remained somewhat dominant in the literature.

The theoretical literature noted above is also significant because it exposes an additional factor to consider in assessing how (or whether) present biases would have observable repercussions in *securities markets*, even if a material subset of *individual traders* are subject to such biases: The extent to which market participants are aware of their own future biases and work to neutralize them. In the presence of such awareness, traders can take measures *ex ante* to neutralize such proclivities. Indeed, a significant design feature in most modern defined contribution plans is meant both to induce individuals to commit ex ante to a future set of trade-offs in their retirement

[18] The discount factor is inversely and uniquely related to the rate of discount rate familiar in discounted cash flow analyses. For a given discount rate r, the equivalent discount factor $\delta = \left(\frac{1}{1+r}\right)$. In the special case of risk-neutral preferences, cash flows at each time period can be substituted for utility flows.

[19] In the above expression, the individual in period t will be indifferent between losing 1 unit of utility in period $t+1$ to gaining X units in period $t+2$, whenever: $\beta\delta\left(-1\right) + \beta\delta^2\left(+X\right) \geq 0 \Leftrightarrow X \geq 1/\delta$. However, once time transitions to period $t+1$, the same individual will favor losing 1 unit of uitility in period $t+1$ to gaining X in period $t+2$, whenever $X \geq 1/\left(\beta\delta\right)$, which exceeds $1/\delta$ whenever $\beta < 1$. A preference reversal would occur whenever $1/\delta < X < 1/\left(\beta\delta\right)$.

savings, as well as to impose "sticky defaults" meant to mimic optimal savings trajectories (Bubb and Pildes 2014). In this vein, the β-δ framework has been adapted to account for the distinction between sophisticated and naïve agents (O'Donoghue & Rabin 2001) to suppose that ex ante, an individual with hyperbolic factor β anticipates that she will be subject to present bias at some level $\hat{\beta} \in [\beta, 1]$. This anticipated value may be as low as the agent's actual β (suggesting complete ex ante sophistication of the agent), or it may be as high as 1 (suggesting complete naïveté). O'Donoghue & Rabin (2001) consider how individuals of varying sophistication may engage in "future choice constraining" measures today (effectively tying their future selves to a metaphorical Ulyssean mast) given the biases they anticipate. In effect, such agents play a game against their future selves. In the context of corporate governance, investors who anticipate future present bias might favor governance structures that constrain future choices (through, say, dual class structures or super-majority provisions).[20]

Finally, our synthesis of the literature suggests at least some avenues through which long-termism and short-termism might coincide (or "match") in governance disputes. Consider, for example, the documented sensitivity of investment to cash flow among overconfident managers (Malmendier & Tate 2005a, 2005b); stingy patterns of shareholder distribution and the amassing of large internal funds also increase the likelihood that a firm will be targeted by hedge fund activism (Brav et al 2008). Similarly, hedge-fund activism tends to focus on R&D investments (Allaire & Dauphin 2015; Coffee & Palia 2015), which overconfident managers disproportionally fancy (Hirshleifer, Low, and Teoh 2010). On the other hand, activism that forces governance changes is not associated with abnormal returns; and governance changes that affect compensation practices or disclosure do not necessarily restrain overconfidence (Malmendier & Tate 2005a, 2005b).

[20] That said, when present biased behavior is induced by institutional constraints (e.g., skewed compensation structures), the actors would similarly be sophisticated about their future preferences, but they would have little to gain by constraining their future choices. (See Section 4, infra, for a more extensive discussion).

3 A Model of Short Termism and Long Termism in Corporate Capital Markets

In this section we propose and analyze a theoretical framework to study the simultaneous interactions of short termism and long termism within a corporate governance / securities market setting. Our aim is to characterize conditions under which short termism and/or long termism can have robust equilibrium effects on pricing, shareholder preferences and corporate decision making, as well as to gain insights on the normative / prescriptive implications of such effects for corporate governance. To concretize our analysis, we focus on overconfidence as the primary source of long termism by managers, and present bias as the primary source of short termism among shareholders.[21]

Although a dynamic model is obviously needed to demonstrate our core arguments, we keep things as simple as possible, positing a set of interactions taking place over three periods: an ex ante period ("Period 0"), and two ensuing productive periods of investment horizon, corresponding to short- and long-term ("Period 1" and "Period 2" respectively). We build from a baseline in which fully rational (unbiased) agents discount all future payoffs according to common a discount factor δ.

We consider a representative firm within a larger population of firms. Each firm is identified with a entrepreneur/manager, denoted as M, whose capabilities are intertwined with the firm's production options. In particular, the firm's profitability is associated with a project that M elects to pursue on behalf of the firm at a cost $I > 0$ borne by the firm. The manager has a choice between a "short term" and a "long term" project, as described below.

- Short-Term Project (ST): The ST project requires the investment to be committed from Period 0 through the end of Period 1. At maturity, the project yields an "unsuccessful" payoff of 0 with probability $(1 - q)$ and a "successful" payoff of $W > 0$ with probability q. Should the firm invest in this project, it will receive the associated payoff at the conclusion of Period 1 and then liquidate, distributing proceeds to investors.

[21] As detailed above, we highlight these two contributing drivers because they seem natural candidates with support in the literature. Many of the basic insights of our posited framework could carry over broadly for many other behavioral drivers of managerial long-termism and shareholder short-termism.

- Long-Term Project (LT): The LT project requires the same up-front investment as ST, but remains illiquid for two periods, maturing only at the end of Period 2. At that time, the LT project pays off either 0 or $V > 0$, with the same probabilities as the ST project $\{1-q, q\}$. Unlike the ST project, we suppose the LT project can come in one of two flavors – "good" or "bad":

  - If the LT project is a good one, then a successful outcome yields a high payoff of $V = V_H$. We suppose that $\delta V_H > W$, and thus the good LT project promises a higher expected present value than ST (at least to an informed, unbiased investor).
  - If the LT project is a bad one, however, then even a successful outcome yields a payoff of $V = V_L = 0$, making it clearly inferior to ST (regardless of time preferences).
  - Denote $\pi \in [0, 1]$ as the *ex ante* probability that the LT project is a good one. With no additional information, LT constitutes a compound lottery *ex ante,* yielding payoffs $\{0, V_H\}$ and associated probabilities $\{1-\pi q, \pi q\}$.
  - That said, we assume that there is additional information: prior to her choice of project, M observes a private signal about the LT project related to its quality. The content of this signal is depicted in the table below, where columns denote the true state of the world, and rows denote the signal M observes. Each cell represents the probability that M observes the corresponding signal conditional on the true state of the world.

	$V = V_L = 0$	$V = V_H$
Pr{"Bad"$\|V_i$}	$1-z$	0
Pr{"Good"$\|V_i$}	z	1

  - Note that M's signal is not completely accurate, but it entails a likelihood of *false positives* in which the manager (with probability z) may observe the project to be good when in fact it is bad. We interpret z to proxy for managerial "overconfidence": As the realized value of z grows, so too does the extent of M's (unwitting) bias towards observing a good signal. We assume z is the realized value of random variable Z, which is distributed on the

unit interval according to cumulative distribution function $H(z)$ and associated density function $h(z)$.

Player M has no wealth of her own to invest, and she must therefore attract equity capital from outside investors. We suppose that investors consist of a population of atomistic agents.[22] All are strategic maximizers, but they exhibit differential degrees of present bias in their time preferences, which we capture with the β-δ framework of quasi-hyperbolic discounting. Specifically, in addition to discounting future payoffs with common factor δ, investors also discount non-current payoffs with an additional multiplicative factor $\beta \in [0,1]$. (For the time being, we assume that investors are "naïve" about their bias, and they therefore predict their future selves to manifest hyperbolic factor $\hat{\beta} = 1$.) We will periodically refer to a realization of β for a specific investor as that investor's "type." Investor types are distributed continuously within the investor population according to a cumulative distribution function $F(\beta)$ and associated density function $f(\beta) > 0$, and total population size ($\int_0^1 dF(\beta)$) is normalized at 1.

Finally, we assume that there are *potential limits to arbitrage,* so that each investor can expend no more than $k \cdot d\beta$, where k proxies for individual capital constraints. Nevertheless, investors *in the aggregate* posses sufficient capacity to finance all projects (so that $\int_0^1 k \cdot f(\beta)\, d\beta = k > I$). As will become apparent shortly, the value of k will play an important equilibrium role in determining if (and how) asset prices reflect equilibrium biases.[23]

3.1 Sequence

The game plays out in three stages ("Stage 0"; "Stage 1"; and "Stage 3") as follows:

Stage 0:

(a) M's degree of overconfidence (z) is realized from distribution $H(z)$. At this stage, however, neither M nor potential investors are able to observe its realized value (and M remains unaware of her realized bias throughout).

[22] Our framework does not analyze debt-financing (at least at this stage), in order to concentrate on potential conflicts between shareholders and the manager. We note, of course, that certain forms of economic activism (e.g., to force leveraged recapitalizations) also place shareholders and incumbent debt holders in direct conflict.

[23] Note that the limiting case where $k \to \infty$ corresponds to unlimited arbitrage, and it is also nested within in our analysis below. Note that k can also proxy increasing or decreasing the size of the market.

(b) M observes a signal about the quality of the LT project (more below) and implements a business plan committing the firm to ST or LT. We assume this signal is observable to M alone. As part of the business plan, M also commits to a corporate governance regime at this stage, captured by the variable γ (described below).

(c) After implementing a business plan, M auctions shares to investors (who observe the business plan, but remain uninformed about both the degree of M's overconfidence and the content of her signal). M is assumed to sell a fraction $(1-\alpha)$ of the firm to outside shareholders, retaining the residual portion α for herself. Although M is free to choose the value of α, she must sell a sufficient outside stake to finance the project's investment costs of I.

Stage 1:

(a) Shareholders who have purchased in Stage 0 are able to observe the realization z, the extent of M's overconfidence; but they remain uninformed of M's prior signal about project quality.[24]

(b) If M has embraced LT, shareholders may use the firm's corporate governance regime to effectively "veto" M, replacing LT with ST — what we will call a *shareholder revolt.* Shareholder revolts are subject to two constraints: *First,* a veto occurs only if a specified fraction γ of outside security holders vote for it. A threshold of $\gamma = \frac{1}{2}$, for example, corresponds to a majority rule, while $\gamma = 1$ corresponds to a unanimity rule.[25] The variable γ parameterizes a core element of shareholders' oversight rights, and in this sense is a serviceable proxy for corporate governance. We assume (for now) that the choice of γ is—like α—a strategic one that M makes at Stage 0(b).[26] *Second,* if shareholder revolt succeeds, the firm must bear switching

[24] A straight-forward generalization of this assumption is that shareholders observe a noisy signal of z. This flourish would add little to our analysis, however, beyond technical complexity.

[25] Some statutes and case law naturally fix a lower bound for γ at 50% for many corporate decisions. However, the analysis below is general enough to include the entire range from 0% to 100%. This makes some sense, given that we define γ to summarize the requisite vote threshold for *non-managerial* shareholders. For many corporate decisions, M's votes count too, and γ would represent the margin required after accounting for M's ownership fraction of α.

Our model also allows for *managerial dictatorships,* impervious even to a unanimous shareholder vote to veto. (An effective dictatorship could be accomplished in any number of ways, including—inter alia—dual class capital struture with control vested in M.) We address this possibility after analyzing the more interesting case of $\gamma \in [0,1]$.

[26] Although we treat γ as a strategic choice, it clearly may interact with either immutable

costs so that the ST project yields only $W_c < W$ when successful.[27] To focus on the most interesting case, assume that W_c remains sufficiently large that it remains a positive net present value investment, and that switching to ST dominates LT (even for unbiased shareholders) in the absence of more information about LT's quality.[28]

(c) If the firm has embraced ST (*ab initio,* or by dint of a shareholder revolt), the applicable ST payoff is realized and the firm liquidates. All shareholders consume their *pro rata* liquidation payoff.

Stage 2:

If M embraced LT and no shareholder revolt ensued, the LT payoff is realized and the firm liquidates. All shareholders consume their *pro rata* liquidation payoff.

3.2 Solving the Model

Our crossing of strategic interactions among preference-biased players poses a challenge for equilibrium analysis. To get a handle on it, we posit an equilibrium concept for biased agents interacting in a game theoretic setting. Our equilibrium concept essentially combines a conventional refinement of sequential equilibrium (Kreps & Wilson 1982; Cho & Kreps 1987) with the intra-personal equilibrium concept developed by O'Donoghue and Rabin (2001). Unlike the latter, we must track players' beliefs about their opponents' likely biases; unlike the former, we must also track players' beliefs and predictions about themselves. In particular, we must specify how one's self-awareness of a behavioral bias may evolve through interactions with outsiders (who may perceive and react to their biases). Our equilibrium concept presumes that players make Bayesian inferences about *other players'* preferences and information, but they need not update their self-assessments in a similar fashion. We will refer to this as a *Bounded Temerity Equilibrium* (or *"B-T Equilibrium").*[29]

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statotory or jurisprudential mandates. Later in the paper, in fact, we will explore whether there are conditions whereby constraining M's choice of γ can ever be value-enhancing. (*Spoiler alert:* Yes).

[27] We treat W_c as as exogenous (but it could be a relevant legal design parameter too).

[28] This requires that $\delta q W_c \geq \max\left\{\pi\delta^2 q V_H, I\right\}$.

[29] We have been unable to find appropriate equilibrium concepts in the literature, leading us to develop our own. We invite readers' suggestions about extant equilibrium concepts that are well-suited to our set-up. (We observe that it is but a freakish coincidence that

Formally, a B-T Equilibrium profile consists of a set of strategies for each player and every information set; a set of beliefs for each player about opponents' preferences and information; a set of beliefs players have about their own preferences; and a subjective updating rule, such that:

1. All players' strategies are optimal at each information set given their beliefs;

2. All players' beliefs about other players along the equilibrium path are sequentially rational and consistent;

3. All players' beliefs about other players off the equilibrium path satisfy the intuitive criterion[30];

4. All players' beliefs about their own preferences are consistent with a specified (potentially non-Bayesian) subjective belief-updating rule.

Note that the setup of our framework presumes that even though players exhibit preference biases themselves, they accurately perceive/anticipate biases in others and update their beliefs about others in a standard way. Our equilibrium concept also requires us to specify the players' knowledge about their own preferences biases at each stage of the game, as well as a rule of how they update those believes as play unfolds. This latter updating process, in contrast, need not be Bayesian. In most of the analysis below, we will impose the assumption that both managers and investors begin with *naïve beliefs about their own biases, and that those beliefs remain naïve as play unfolds.* That is, investors are aware of the distribution of managerial overconfidence ($H(z)$) when they bid, but that the manager believes that she is a sober rationalist, even as those around her react to her as if she is not (such as through a shareholder revolt). Conversely, the manager is aware of the distribution of short-termism among investors ($F(\beta)$), but investors do not understand their own present biases, and their understanding does not

the "B-T" abbreviation corresponds with the respective first letters of each of the authors' surnames.)

[30] See, e.g., Cho & Kreps (1987). The intuitive criterion is sufficient to generate unique equilibria in our framework. We conjecture, however, that our equilibrium concept could lend itself to other refinements as needed.

change as play unfolds.[31]

It will be useful to have some additional notation ready to describe the players' behavior strategies:

- Let $\theta \in [0,1]$ denote the probability that M opts for the LT project in Stage 0a upon observing a "Good" signal;
- Let $\tau \in [0,1]$ denote the probability that M opts for the LT project in Stage 0a upon observing a "Bad" signal;
- Let $\mu \in [0,\infty)$ denote the equilibrium likelihood ratio of $\frac{\tau}{\theta}$ (an expression that appears repeatedly in the analysis below);
- Let $\phi_\beta^i \in [0,1]$ denote the fraction the capital constraint invested by investor of type β given the manager's choice of business plan i, where $i \in \{ST, LT\}$.
- Let $\sigma(\beta) \in [0,1]$ denote the probability that a shareholder of type β will vote to support (i.e., not to veto) M's choice in Stage 1a after M has selected the LT project.

A B-T Equilibrium of the game thus consists of a 7-tuple strategy profile $\left\{\theta, \tau, \alpha, \gamma, \phi_\beta^{ST}, \phi_\beta^{LT}, \sigma_\beta\right\}$ and beliefs among investors and M that satisfy conditions 1-3. As noted above, we will posit a particular belief updating rule coinciding with extreme naïveté about one's own biases, and they do not update their self assessments even as they observe others' equilibrium play.

As with other equilibrium concepts, the appropriate procedure for characterizing the B-T equilibrium within our framework is to solve backward, starting at the final stage. Because no strategic choices are made at either the LT Project Realization Stage (Stage 2) the SH Project Realization Stage (Stage 1c), we can commence the analysis with the shareholder veto stage for firms that have pursued the LT project (Stage 1b). We state our intermediate results in a series of lemmas (Lemmas 1-6), culminating in our central result at the end (Proposition 1).

[31] Other generalizations are possible. For example, following O'Donoghue & Rabin (2001), an investor of type β might predicts her future self to be susceptible to a present bias parameter of $\hat{\beta} \in [\beta, 1]$. Under our complete naivete assumption, $\hat{\beta} = 1$. Our framework naturally extends to belief structures involving other values of $\hat{\beta}$, which may more naturally fit shareholders whose present bias is induced rather than fundamental. We return to this issue in Section 4.

3.2.1 Shareholder Veto Stage (Stage 1b)

Note that shareholder vetoes are (by hypothesis) inapplicable to firms embracing ST project, and thus the analysis below is confined to contexts where M has opted for the LT project. Because shareholders cannot observe the signal observed by M, they do not possess symmetric information about the project when they vote. At this stage they can observe only (i) that M has previously selected the LT project; and (ii) the realized extent of M's overconfidence (z).[32]

Given the strategy profile described above, consider how shareholders form expectations about the project's quality when the manager has implemented the long term project. There are three ways the LT project might have been chosen. First, LT may genuinely be of high quality and M chose it after observing a good signal (which happens with probability $\pi\theta$). Second, LT may be of low quality, but M's optimism bias caused her to observe a good signal and choose it (which happens with conjectured probability $(1-\pi)\,z\theta$). Third, LT may be of low quality *and* M also observed a bad signal, but she strategically chose to pursue LT anyway (which happens with conjectured probability $(1-\pi)\,(1-z)\,\tau$).

According to Bayes' rule, shareholders of the LT firm formulate a probabilistic assessment $\bar{\pi}$ that the project is good one, conditional on M having chosen to pursue it, and the observed value of z:

$$\begin{aligned} \bar{\pi} &= \frac{\Pr\{LT|Good\}\Pr\{Good\}}{\Pr\{LT\}} \\ &= \frac{\theta\pi}{\theta\pi + (1-\pi)\,z\theta + (1-\pi)\,(1-z)\,\tau} = \frac{\frac{\pi}{1-\pi}}{\frac{\pi}{1-\pi} + z + \mu\,(1-z)} \end{aligned} \tag{2}$$

Notice that when the base-rate probability of high quality (π) approaches one, so too does the shareholders' assessment of $\bar{\pi}$, irrespective of M's strategic

[32] The alert reader may anticipate that this structure above may give an incentive to the entrepreneur / manager who observes a bad signal to "pool" with the good manager when selling shares. As we will see in below, for such a pooling equilibrium to exist the "bad" manager must also pool with the "good" manager in the size of the share offering, keeping the residual ownership for herself. When M has observed a bad signal, the value of this residual share is zero, and the manager will raise only enough capital to fund the project. Consequently, pooling equilibria do not extend to this setting, as they might if, say α were not a strategic variable. (See Lemma 3).

choices. Furthermore, as z and μ approach zero, $\bar{\pi}$ also approaches 1, since the choice of a LT project is near-perfect signal to the market of high quality. Intuitively, however, $\bar{\pi}$ is strictly decreasing in both z and μ, but at a decreasing rate – as will become clear below (since they are structural substitutes for one another).

Given the posterior beliefs in (2), consider how the firm's shareholders will vote on whether to veto the manager's business plan. If M has chosen a LT project, a representative shareholder will favor a veto if she perceives the present value of the LT project no greater than the ST project (factoring in switching costs[33]). This logic, in turn, yields the following equivalent Lemmas (all proofs may be found in the Appendix):

Lemma 1a: *A shareholder with present bias β supports M's choice of LT if $z < \hat{z}(\beta)$, where:*

$$\hat{z}(\beta) = \left(\frac{\beta\delta V_H}{W_c} - 1\right)\left(\frac{\pi}{(1-\pi)(1-\mu)}\right) - \frac{\mu}{(1-\mu)} \tag{3}$$

Lemma 1b: *A manager with overconfidence level z wins support from all shareholder types $\beta > \bar{\beta}(z)$, where*

$$\hat{\beta}(z) = \left(1 + \frac{(1-\pi)(z+\mu-z\mu)}{\pi}\right) \cdot \frac{W_c}{\delta V_H} \tag{4}$$

Lemma 1a states that—holding present bias fixed—the shareholder will choose to support the manager when the manager is not too optimistic ($z < \hat{z}(\beta)$). Lemma 1b states the same condition through a different lens—holding overconfidence fixed, a shareholder will prefer to support M when the shareholder is sufficiently long-termist (i.e., $\beta > \hat{\beta}(z)$). These dual conditions on z and β, moreover, are *linear and increasing in one another*, suggesting a structural trade-off between overconfidence and present bias (see Figure 2 below). Shareholder support wanes as *either* managers become more overconfident, or as shareholders become more present-biased (or

[33]For simplicity, we assume that when a shareholder is indifferent between supporting and vetoing, she chooses to veto. Given the continuous distribution of shareholder types, there is no loss of generality in this assumption.

both).

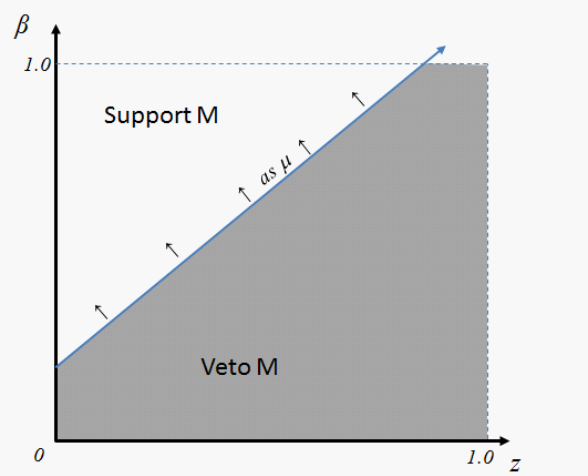

Figure 2: Veto Preference in z-β space.

Note from the Lemmas and accompanying Figure that there is always a set of investor preferences who favor vetoing M as a categorical matter (e.g., even if $z = 0$). Indeed, the most present-biased investors completely discount *all* future payoffs (regardless of magnitude).[34] Moreover, as the Figure demonstrates, once M becomes sufficiently overconfident, there is no investor who will support her, because the manager's signal is simply unreliable.[35] Finally, observe from the figure that as $\mu = \frac{\tau}{\theta}$ grows, the frontier separating vetoers and supporters shifts up and to the left, and thus vetoes become progressively likely. This is intuitive, since μ captures the relative frequency of strategic to honest signals from M, and thus increases in μ portend a lower likelihood that the manager observed a good signal.

We are now in a position to characterize the outcome of the veto stage. Suppose that in equilibrium, investors who become shareholders of the firm have time preferences distributed according to density $g(\beta)$, and associated cumulative distribution $G(\beta)$. (There is no requirement that the distribution of shareholders in equilibrium is the same as the distribution of potential investors; will must therefore derive $G(\beta)$ below.) Note that it is incentive compatible for the shareholders of the firm to vote sincerely at this stage,

[34] To see this, note that $\bar{\beta}(0) = \left(1 + \frac{(1-\pi)}{\pi}\mu\right) \cdot \frac{W_c}{\delta V_H} > 0$. Whether such investors *actually become shareholders of the firm in equilibrium,* of course, is another matter – and one we take up below.

[35] To see this, note that at $z = 1$, $\bar{\beta}(1) = \frac{W_c}{\pi \delta V_H} > 1$, since by hypothesis, $W_c > \pi \delta V_H$.

since the ensuing stages are mechanical and not strategic.[36] Consequently, shareholders as a group will vote to veto the manager whenever:

$$G\left(\hat{\beta}\left(z\right)\right) \geq \gamma \Leftrightarrow \hat{\beta}\left(z\right) \geq G^{-1}\left(\gamma\right) \equiv \beta_{\gamma} \tag{5}$$

In other words, at a given level of managerial long-termism (z), a successful shareholder revolt will occur given if the indifferent shareholder $\hat{\beta}\left(z\right)$ and all those who are more impatient constitute a fraction of the firm's ownership no less than γ. Equivalently, a revolt will occur if the present bias of the pivotal shareholder, β_{γ}, is less than the critical cutoff value for support, $\hat{\beta}\left(z\right)$. Notice that *ceteris paribus*, as a greater mass of short-termist shareholders predominates at the firm, the likelihood of a veto also increases. Notice too, however, that *ceteris paribus*, a veto is also more likely as M's overconfidence (z) grows in magnitude. This fundamental intuition that both investor short termism and managerial optimism can enhance the chances of shareholder revolts animates much of our analysis.[37]

[36] There may also be equilibria of the voting stage that entail "insincere" votes by many parties simply because the believe that they would never be the pivotal voter. For example, the strategy profile "everyone votes in to support M" may involve insincere voting from shareholders who would prefer to veto, but no single shareholder has an affirmative incentive to deviate. However, the sincere voting strategy is the only one robust both to all values of γ as well as to small "trembling hand" perturbations to others' strategies. We therefore concentrate attention to sincere voting equilibria.

[37] It is worth noting in passing how the time inconsistency of shareholder preferences bears on the veto decision relative to investors' ex ante evaluation of the firm. Recalling that shareholders are assumed naive, if one were to ask a shareholder as of period 0 to predict her voting behavior in Period 1, she would predict that her later self would favor veto if and only if:

$$\beta\delta qW_c \cdot dx > \beta\delta^2 q\bar{\pi}V_H \cdot dx, \tag{6}$$

which simplifies to the following version of Lemma 1a:

$$z > \bar{z}\left(1\right) = \left(\frac{\delta V_H}{W_c} - 1\right)\left(\frac{\pi}{\left(1-\pi\right)\left(1-\mu\right)}\right) - \frac{\mu}{\left(1-\mu\right)} \tag{7}$$

Note that this condition is invariant in β, as distinguished with shareholders' actual behavior from (4), which turns crucially on β being above cutoff value of $\bar{\beta}\left(z\right)$: because shareholders' short-termism is naive, they mispredict their future inter-temporal trade-offs, with all of them predicting a vote decision coinciding with rational actors. Consequently, as of time 0, all prospective shareholders – if they were sophisticated and anticipated the time inconsistency of their preferences – would gain by committing themselves to a voting structure that ensures a veto only when the least short-termist shareholder would favor it ($\beta = 1$). Such a structure could be accomplished, for example, by giving substantial

3.2.2 Share Auction Stage (Stage 0c)

We now step back yet again to Stage 0, where M—having selected a project—auctions a fraction of ownership $(1-\alpha)$ to investors. The share auction has several critical attributes that are worth noting. First, recall that at this stage shareholders are unaware of the manager's degree of overconfidence, and they must evaluate their investment over the support of z. Second, because investors are differentiated from one another by their degree of present bias, they will place differential valuations on the company. The manager will therefore find it most profitable *ex ante* to place as many shares as possible in the hands of the highest valuing shareholders (i.e., those with the largest possible values of β). Third, to the extent that there are any limits to arbitrage (*i.e.,* if $k < \infty$), the manager must seek funds from investors who have at least some present bias ($\beta < 1$). Fourth, because the marginal investor's present bias will introduce a discount on the shares, the manager will attempt to retain as large a fraction of ownership as she can. And finally, recall that ST and LT both require an up-front investment of I to move forward, and thus regardless of which project M has chosen.

Analysis of these conditions yields the following two related Lemmas:

Lemma 2: *For sufficiently slack investor access to capital (k sufficiently large), the manager will be able to raise sufficient outside funds to invest. Regardless of the project selected by M, the equilibrium ownership of the firm is distributed over support $\beta \in [\beta^*, 1]$ according to cumulative distribution function $G(\beta) = 1 - \frac{k}{I}(1 - F(\beta))$, where $\beta^* = F^{-1}\left(1 - \frac{I}{k}\right)$. The preferences of the marginal shareholder, β^*, fully determine the market valuation of the firm.*

Lemma 3: *There does not exist a B-T Equilibrium in which M chooses the LT project after observing a bad signal (and thus $\tau = \mu = 0$).*

Lemma 2 characterizes the equilibrium distribution of share ownership in the firm. It delivers the core insight that this distribution is invariant to either M's project-selection choice or the prospects of a later shareholder revolt. While perhaps surprising on first blush, this result is intuitive: regardless of the project selected, the most efficient source capital is always the same set

governance power to the non-short-termist by (say) setting the voting threshold $\gamma = 1$ (a unanimity rule), or granting a voting proxy to the most patient of shareholders (which effectively accomplishes the same result).

of investors: those who have the smallest degree of present bias, and who can most efficiently underwrite the required up-front investment. Indeed, regardless of whether M opts for the ST or LT project, investors will have to wait until a future period to realize any liquidity. And, because both projects require an identical up-front investment of I, the set of investors must be identical regardless of project chosen.[38]

The intuition underlying Lemma 3 is intertwined with Lemma 2. Because M must accept a progressively larger discount as the size of the stock offering grows, so long as M believes the project to be a good one, she will raise only enough to finance the project, but no more (since the manager believes the project to be more profitable than does the marginal investor). When the manager has observed a bad signal, in contrast, she knows the project to be bad so that $V = V_L = 0$; she might conceivably wish to sell the entire project to outside investors. Doing so, however, will signal to outside investors that M has observed a bad signal, they will refuse to invest. Thus when M has observed a bad signal but nonetheless chooses LT, she can do no better than to pool with the manager who has observed a good signal, raising just enough to finance the project (I). Even if such a pooling equilibrium were possible, the strategy would leave the "bad signal" flavor of M with no additional return when the project (inevitably) fails. A strictly dominant strategy would be for M to choose ST upon observing a bad signal—revealing her information, but allowing her to raise capital *and* retain positive residual rents.

Lemmas 2 and 3 simplify the analysis in two ways. First, they pin down the precise equilibrium distribution shareholder preferences (Lemma 2), which in turn allows us to characterize the "pivotal" shareholder whose vote tips the balance in a shareholder revolt (see below). And second, they allow us to concentrate solely on separating equilibria or partial pooling equilibria in which $\tau = 0$ and $\theta \in [0, 1]$.

[38] Note that this does **not** imply investors place *identical valuations* on M's project choice; in general they will not, and any differences will be reflected both in per-share price and the fractional dilution $(1 - \alpha)$ that M must cede to outside investors—a fraction that is decreasing in the shareholders' expectation of total enterprise value (analyzed below).

Note also from Lemma 2 that β^* is strictly increasing in k: as k grows, limits to arbitrage slacken and it becomes progressively easier to finance the project with longer-term investors. In the special limiting case where $k \to \infty$, the equilibrium support of investors converges to a mass point at $\beta = 1$, and equilibrium asset prices no longer reflect short-termism.

Market Valuation for ST Project We now move on to analyze the valuation that the market places on the firm in the posited equilibrium. Consider first the case where the manager has chosen the ST project. Here, characterizing the market's valuation is relatively straightforward, since the ST project choice negates the relevance of managerial overconfidence (but investor short-termism can still affect valuations). Here, at stage 1, the firm has expected value qW, which the marginal investor discounts further ex ante β^*, implying the following:

Lemma 4: *In any B-T Equilibrium, the implied market valuation of the ST firm is invariant in γ, and given by:*

$$\omega_{ST}(\gamma) = \omega_{ST} = \beta^* \cdot \delta qW \tag{8}$$

This expression establishes the total market valuation of the firm. (Note once again that as $k \to \infty$, $\beta^* \to 1$ and this market valuation converges to the unbiased expected present value of the firm). It therefore follows that in order to raise the requisite capital, the manager must dilute her stake by $(1 - \alpha_{ST})$ to satisfy the condition $\omega_{ST}(1 - \alpha_{ST}) = I$, and thus:

$$(1 - \alpha_{ST}) = \frac{I}{\omega_{ST}} = \frac{I}{\beta^* \delta qW} \tag{9}$$

Consistent with intuition, the extent of dilution is decreasing in the discount factor (δ), the probability of a successful project outcome (q), the payoff from a successful outcome (W), and (via β^*) the financing capacity of individual shareholders (k). Given this degree of dilution, the expected payoff M expects when she pursues the ST project is:

$$\begin{aligned} \alpha_{ST} \cdot \frac{\omega_{ST}}{\beta^*} &= \left(1 - \frac{I}{\omega_{ST}}\right) \frac{\omega_{ST}}{\beta^*} \\ &= \frac{\omega_{ST} - I}{\beta^*} \end{aligned} \tag{10}$$

This payoff structure is very intuitive, consisting of the net present value of the ST project ($\delta qW \equiv \frac{\omega_{ST}}{\beta^*}$) less the investment cost (I) inflated by $\left(\frac{1}{\beta^*}\right)$ reflecting the price discount that must be granted to the marginal investor (and reflecting that investor's present bias).

Market Valuation for LT Project Now consider the case where the manager has embraced the LT project. As we know from Lemma 3, this case is a candidate for an equilibrium only when the manager has observed the good signal. The complication, of course, is that here both M's overconfidence and shareholders' short-termist veto preferences come into play. Moreover, potential shareholders invest knowing that they may later (in equilibrium) stage a shareholder revolt upon observing M's overconfidence (a contingency that feeds back on how they price LT firm). To get an appreciation for how these forces interact, consider Figure 3, where the equilibrium support of shareholders on $[\beta^*, 1]$ (per Lemma 2) is depicted on the vertical axis, with the range of managerial overconfidence depicted on the horizontal axis. Recall that for any value of z, the shareholder types most interested in vetoing M cluster at the low end of the shareholder support $\left[\beta^*, \hat{\beta}\right] \subseteq [\beta^*, 1]$.

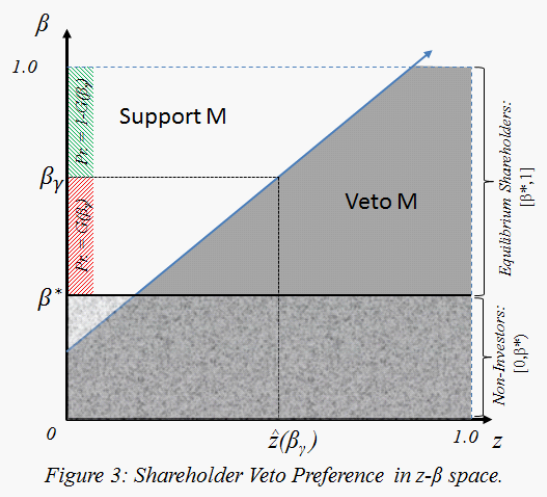

Figure 3: Shareholder Veto Preference in z-β space.

Given this ordering, it immediately follows that for any governance regime γ there exists a unique "pivotal" shareholder (β_γ) whose vote tips the balance in a shareholder revolt. The value of β_γ is characterized by the following condition:

$$\begin{aligned} G\left(\beta_\gamma\right) &= 1 - \frac{k}{I}\left(1 - F\left(\beta_\gamma\right)\right) = \gamma \qquad (11) \\ &\Leftrightarrow \\ \beta_\gamma &= F^{-1}\left(1 - \frac{I}{k}\left(1 - \gamma\right)\right) \end{aligned}$$

Accordingly, a veto will occur whenever the manager's observed degree of realized overconfidence exceeds $\hat{z}\left(\beta_\gamma\right) \equiv \left(\beta_\gamma \frac{\delta V_H}{W_c} - 1\right) \cdot \frac{\pi}{1-\pi}$, the critical point where M loses support from the pivotal shareholder.

At the auction stage, of course, shareholders have yet to learn the manager's degree of overconfidence (which they discover only in Stage 1). Their auction-stage valuation, then, can depend only of the prior distribution of managerial overconfidence $H(z)$, and the fact that the manager has opted for LT. This is sufficient to permit investors to formulate (i) Bayesian posteriors about managerial overconfidence given the project choice, (ii) expectations about the likelihood of a later shareholder revolt, and (iii) the expected consequences that would ensue therefrom. Analysis of these considerations in relation to the marginal investor's valuation of the LT firm generates the next (important) Lemma:

Lemma 5: *In any B-T Equilibrium, the implied market valuation of the LT firm is given by:*

$$\omega_{LT}(\gamma) = \beta^* \delta q W_c \cdot \left(\frac{\frac{\pi}{1-\pi} + \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right) H(\hat{z}_\gamma) + E(z|z \geq \hat{z}_\gamma)(1 - H(\hat{z}_\gamma))}{\frac{\pi}{1-\pi} + E(z)} \right) \quad (12)$$

For all $k < \infty$, moreover, $\omega_{LT}(\gamma)$ is strictly increasing in $\gamma \in [0,1]$, and is maximized by corporate governance regime $\gamma = 1$, requiring a unanimous vote to veto M. Under such a rule, the firm's implied market valuation is:

$$\omega_{LT}(1) = \beta^* \delta q W_c \cdot \left(\frac{\left(\frac{\pi}{1-\pi}\right) + E\left(\max\left\{z, \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right)\right\}\right)}{\frac{\pi}{1-\pi} + E(z)} \right) \quad (13)$$

Lemma 5 delivers two results that are helpful in characterizing the B-T Equilibrium of the game. First, it gives an expression for the market valuation of the LT firm. Although admittedly complex, the expression in (12) essentially consists of a baseline value equal to the marginal shareholder's valuation of the firm if a revolt were certain (i.e., $\beta^* \delta q W_c$) times a "multiplier" that never smaller (and is generally strictly larger) than one. Note from both expressions (12) and (13) that the multiplier contains an option-like payoff in z, the manager's level of optimism. This component reflects the value of the "real option" shareholders of the LT firm have to veto M's business plan after

observing z. And, as with other options, its value tends to grow—as does the market value of the LT project—when one increases the variability on z. Given this valuation, one can immediately deduce the fraction by which the manager of the LT firm must dilute her stake to procure financing:

$$(1 - \alpha_{LT}) = \frac{I}{\omega_{LT}(\gamma)} \tag{14}$$

We will return to this expression below.

Second, Lemma 5 states that the implied market valuation of the firm *at the auction stage* is strictly increasing in γ, and is uniquely maximized by a *unanimity rule* ($\gamma = 1$). This may seem surprising on first blush, but it makes clear intuitive sense when one considers the role of time-inconsistent, investor short-termism in assessing the prospects for a revolt. For any value $\gamma < 1$, the pivotal shareholder will manifests short termism ($\beta_\gamma < 1$), and accordingly there exist a range of realizations on z that induce a shareholder revolt even though retaining the LT project would generate a larger continuation value. Although each individual shareholder fails to realize her own susceptibility to short termism, she is rational about *other* shareholders' biases, and recognizes that a $\gamma < 1$ rule may result in inefficient vetoes. When $\gamma = 1$, in contrast, the pivotal shareholder is unbiased ($\beta_\gamma = 1$), and no inefficient vetoes occur. Indeed, from their ex ante perspective, all shareholders individually believe that they will manifest no short-termism in Period 1, and they therefore (erroneously) consider the $\gamma = 1$ rule to be a perfect match for their future preferences.

3.2.3 Project Choice Stage (Stage 0b)

We now step back once again to the project choice stage, in the light of the strategic dynamics noted above. The manager anticipates the posterior beliefs that her choice of will induce among investors (wrongly, in M's opinion). She also anticipates the equilibrium distribution of shareholder preferences, the equilibrium likelihood of a shareholder revolt, the market valuation from each project, and the degree of dilution she must incur to finance each project choice. Combining these pieces of information, M will assess the conditions under which her choice of the LT project is attractive to her and resilient against shareholder revolt.

Lemma 6: *In any B-T Equilibrium, the manager always opts for the ST project after receiving a bad signal. After receiving a good signal, M will opt for LT project only if* $\gamma > \hat{\gamma}$*, where:*

$$\hat{\gamma} \equiv Max\left\{0, 1 - \frac{k}{I}\left(1 - F\left(\frac{W_c}{\delta V_H}\right)\right)\right\} \tag{15}$$

Lemma 6 gives a necessary condition for the manager to pursue the LT project after a good signal. It reflects the strategic consideration that M will only pursue the LT project only if she believes that shareholders won't veto her. Because M remains oblivious to her own overconfidence, however, she is certain that shareholders will later observe her to be perfectly rational ($z = 0$). Thus, from the manager's perspective, shareholders will revolt against her only if the pivotal shareholder would systematically oppose any manager, regardless of overconfidence. The critical value of γ^* given in the Lemma is the governance regime at which short-termist shareholders would veto even a fully rational manager (which M believes herself to be).

It is of course important to note that the value of $\gamma \in [0, 1]$ is assumed to be a *strategic choice* for M. Consequently, Lemma 6 need not bind M's behavior because it is always possible to choose $\gamma > \gamma^*$. Indeed, as we will see below, M prefers setting $\gamma = 1$, since that ensures the highest market valuation of the project (per Lemma 5), minimizes the required dilution (also per Lemma 5), and entails the smallest chance of a shareholder revolt. Note also that even when M chooses $\gamma = 1$, the condition stated in Lemma 6 is necessary, but it is not sufficient to attract M to the LT project after observing a good signal. Because investors anticipate M's overconfidence, they may demand a substantially larger dilution to invest in the LT project; consequently, M may be better off pursuing ST, where the equilibrium dilution may be smaller.

3.2.4 B-T Equilibrium

With Lemmas 1-6 in hand, we are now in position to aggregate them and characterize the B-T Equilibrium for the model. This characterization is reflected in our central result, stated below as Proposition 1.

Proposition 1: *Suppose investors and managers are naïve about their present biases and overconfidence (respectively), and they do not update their self assessments. The B-T Equilibria*[39] *of the game depend on investors' capital constraint k, and are as follows:*

	$k < k^*$	$k = k^*$	$k > k^*$
θ	0	$\theta \in [0,1]$	1
τ	0	0	0
γ	N/A	1	1
α	$1 - I/\omega_{ST}$	$\begin{cases} 1 - I/\omega_{ST} \; if \; ST \\ 1 - I/\omega_{LT}(1) \; if \; LT \end{cases}$	$1 - I/\omega_{LT}(1)$
ϕ_β^{ST}	$\begin{cases} 1 \; if \; \beta \geq \beta^* \\ 0 \; else \end{cases}$	$\begin{cases} 1 \; if \; \beta \geq \beta^* \\ 0 \; else \end{cases}$	$\begin{cases} 1 \; if \; \beta \geq \beta^* \\ 0 \; else \end{cases}$
ϕ_β^{LT}	$\begin{cases} 1 \; if \; \beta \geq \beta^* \\ 0 \; else \end{cases}$	$\begin{cases} 1 \; if \; \beta \geq \beta^* \\ 0 \; else \end{cases}$	$\begin{cases} 1 \; if \; \beta \geq \beta^* \\ 0 \; else \end{cases}$
σ_β	N/A	$\begin{cases} N/A \; if \; ST \\ 1 \; if \; LT \; \& \; \beta \geq \beta_\gamma \\ 0 \; else \end{cases}$	$\begin{cases} 1 \; if \; \beta \geq \beta_\gamma \\ 0 \; else \end{cases}$

where $\omega_{ST}, \omega_{LT}(1), \beta^*$, and β_γ are as defined above, and k^* is given by:

$$k^* \equiv \frac{I}{1 - F\left(\frac{I}{\delta q(\delta V_H - W)} \cdot \left(\frac{E(z) - \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)}{\frac{\pi}{1-\pi} + \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)}\right)\right)} \tag{16}$$

Although Proposition 1 predominantly aggregates the results from Lemmas 1 - 6, it contains a few additional insights. In particular, the Proposition states that M's proclivity to pursue the LT project after a good signal hinges critically on limits to arbitrage (reflected through capital constraint k). This is because, as noted above, k is inversely related to the role that present bias

[39] The belief structures supporting the stated strategy profile are easy and intuitive, and we therefore omit lsting them to economize on space. The only small caveat concerns equilibrium beliefs off the equilibrium path, when $k < k^*$ but the manager nonetheless selects LT. Here, one set of beliefs that suffices under the intuitive criterion (per Cho & Kreps 1987) is that investors place probability 1 on the manager having observed a bad signal.

plays in equilibrium pricing: When k is large, equilibrium ownership is vested in relatively patient investors who are less susceptible to present bias (i.e., β^* is large). As k shrinks, however, M must sell "deeper" into the population of potential investors, drawing in a marginal shareholder who grows increasingly present biased (and β^* shrinks). This turns out to impose a larger incremental penalty in equilibrium on the LT project (where investors' growing present biases amplify the Bayesian discount they already demand for overconfidence) than it has on the ST project (where overconfidence is immaterial). Eventually (once $k < k^*$), the manager becomes categorically uninterested in LT. The differential effect that k has on M's project choice has intriguing policy implications – which we take up in the next section. Note that for the most part, Proposition 1 identifies a *unique* B-T Equilibrium profile; the only exception is the knife-edge case where $k = k^*$, in which case M is indifferent between ST and LT and is willing to play any mixed strategy. Even there, however, once the outcome of this mixed-strategy choice is realized, the remainder proceeds in pure strategies matching one of the other cases.

Finally consider the parametric ingredients of k^* given expression (16) from Proposition 1. Although its functional form is somewhat intricate, a few aspects stand out. The value of k^* is strictly increasing in the required up-front investment for either project (I). This is intuitive, since a larger up-front investment increases the stakes for shareholders, reducing their willingness to bear the risk of overconfidence in the LT project. Similarly, as the payoff associated with the ST project (W) increases, k^* grows and both shareholders and M become more attracted to the ST project. Note also that – just as with ω_{LT}, embedded within k^* is an call-option-like payoff on z, the manager's level of optimism (relative to a strike price of $\left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right)$). This payoff reflects the shareholders' real option to veto a managerial decision to pursue the LT project. And, like other call options, this one becomes more valuable as z becomes more variable. Accordingly, k^* tends to shrink—and the LT project grows easier to support in equilibrium—when one increases the variability on z.

4 Discussion, Implications and Extensions

Several concomitants of Proposition 1 (and its supporting Lemmas) have interesting policy implications for the activism debate, and we highlight some

of them in this section. In addition, we consider various possible extensions to the model, offering conjectures about whether/how they would change our central results. Finally, we offer some tentative hypotheses about how to test and/or calibrate our theory with real-world data.

4.1 Policy Implications

Our central result carries interesting implications for ongoing legal and policy debates over activism and short-termism. We consider several of them below, through a series of corollaries.

Corollary 1: *When $k < k^*$, short-termism is so pervasive in equilibrium that managers categorically eschew the LT project (even when LT is value maximizing), and shareholder revolts do not occur in equilibrium.*

Corollary 1, which is a direct implication of Proposition 1, bears some resemblance to the common allegation (e.g., Lipton 2015) that the "threat" of activism browbeats managers into eschewing long-term investments *writ large*. It thus has obvious relevance for the activism debate in contexts where limits to arbitrage bind. For example, if $k < k^*$ across all firms, then we would expect managers systematically to embrace short-term projects. A manager who makes a "mistakenly" embraces LT (i.e., off the equilibrium path) would eventually be vetoed and compelled to rejoin the remainder who have embraced the ST project (incurring a switching cost along the way). Over the medium to long term, however, we would expect such a firm to earn returns comparable to other ST firms. (Cf. Bebchuk et al 2015).

It is important to note that when the predicate conditions of Corollary 1 hold, shareholder revolts should not occur *at all* in our model's equilibrium (or, in practical terms, they would be exceedingly rare). That one observes them frequently in practice, then, casts some doubt on the condition stated in Corollary 1 – at least insofar as k^* takes on a common value across all firms.

Corollary 2: *When $k \geq k^*$, shareholder revolts occur in equilibrium with positive probability, and they systematically target the most overconfident managers, leaving less biased managers unscathed. Nevertheless, when $k < \infty$ and $\gamma < 1$, shareholder revolts are also overinclusive, targeting some long-term projects whose continuation would be value maximizing.*

Corollary 2 states that even when $k \geq k^*$, equilibrium behavior is a mixed bag on efficiency grounds. On the one hand, while managers have the gumption to opt for LT upon receiving a good signal, they tend to be overly smitten with such projects, and their unwarranted attraction to LT grows in the degree of their overconfidence. Consequently, overconfident managers will be highly over-represented within firms embracing long-term projects. It is therefore unsurprising that equilibrium shareholder revolts target the most overconfident of these managers (in terms of our model, those for whom $z \geq \hat{z}_\gamma = \frac{\pi}{1-\pi} \cdot \left(\beta_\gamma \delta V_H / W_c - 1\right)$).

That said, shareholder revolts can also "jump the gun," deposing even managers who have embraced *value-maximizing* long-term strategies. Within our model, gun-jumping occurs generically unless either $k = \infty$ or $\gamma = 1$ (or both). Outside of these extreme cases, the equilibrium marginal purchaser exhibits present-biases (*i.e.*, $\beta^* < 1$), as does the pivotal shareholder holding the swing vote in a revolt (*i.e.*, $\beta_\gamma \in (\beta^*, 1) < 1$). Consequently, the pivotal shareholder will be biased towards the immediate payoff associated with reverting to the short term project. This effect disappears only when the pivotal shareholder is unbiased – which happens in our model when either (i) capital constraints do not bind ($k = \infty$), or (ii) the governance rule requires unanimity, vesting decisional control in the unbiased shareholder $\left(\gamma = \beta_\gamma = 1\right)$. Of course, if the manager has complete control over γ, she can fix $\gamma = 1$ and eliminate the gun-jumping problem. In some contexts, however, M may not be free to do so (a topic we return to below).

Corollary 3: *When $k < \infty$ and $\gamma > 0$, a firm experiencing a shareholder revolt experiences a discontinuous upward jump in its market valuation, which need* ***not*** *reflect market fundamentals, but rather to the time-inconsistency of the marginal investor's present bias. Moreover, this upward discontinuity can occur* ***even when*** *the shareholder revolt destroys value.*

Corollary 3 reflects a phenomenon that is common to many behavioral economics models with time-inconsistent preferences: As time transitions forward, time preferences shift too (and rankings can invert). In our model at the *ex ante* stage, present-biased shareholders trade off the payoffs from ST and LT relatively even-handedly, because both projects promise payoffs that obtain at least a period into the future. Once Stage 1 obtains, however, present-biased shareholders remove their discount on the ST project

(which pays off immediately) while retaining it in the LT project. The pivotal shareholder $\left(\beta_\gamma\right)$ will precipitate a revolt when and only when her perceived valuation of staying with LT (or $\beta_\gamma \times [q \cdot \delta V_H \cdot \bar{\pi}(\hat{z})]$) is just offset by her perceived valuation of an immediate payoff from reverting to ST (or $q \cdot W_c$); and consequently M is deposed only when $z \geq \hat{z}_\gamma$. However, it is the *marginal investor* (β^*)—not the *pivotal shareholder* $\left(\beta_\gamma\right)$—who determines equilibrium prices; and the former is, by construction, more present-biased than the later $\left(\beta^* < \beta_\gamma\right)$.

To better understand the intuition behind Corollary 3, consider two hypothetical firms A and B, whose managers manifest overconfidence in the degrees $z_A = \hat{z}_\gamma + \varepsilon$ and $z_B = \hat{z}_\gamma - \varepsilon$, where ε is infinitesimally small. Note that these firms are *just* on opposite sides of the demarcation line presaging a shareholder revolt: one occurs with firm A, but not with firm B. Nevertheless, because ε is small, the pivotal shareholder (by hypothesis) values the two firms approximately equally.

Market valuations tell another story: When z_A is revealed, equilibrium prices will adjust to reflect the marginal investor's valuation of the inevitable revolt and ensuing reversion to ST: this amount is once again $q \cdot W_c$. When z_B is revealed, prices also adjust, now to reflect the marginal investor's valuation of maintaining the status quo, given z_B: this amount is $\beta^* \times [q \cdot \delta V_H \cdot \bar{\pi}(z_B)]$. Because $\beta^* < \beta_\gamma$, this latter amount will reflect a discount of Firm B (the one that survives a revolt) relative to Firm A (the one that succumbs). Consequently, Firm A will begin to trade at a premium over Firm B, since pricing is determined by the most biased shareholder in equilibrium, β^*. By this same logic, it becomes immediately clear that whenever $\gamma < 1$, the even the pivotal shareholder will exhibit present bias ($\beta_\gamma < 1$), and her preference for revolting against Firm A will be inefficient; and yet the revolt induces a positive abnormal return for Firm A relative to Firm B (where the revolt fails, efficiently).

This result has obvious implications for understanding the relationship between price movements and activism. As has been well documented, activism generally results in positive abnormal returns — a result that appears to be robust in the literature (e.g., Krishan, Parnoy & Thomas 2015). Corollary 3 suggests that while such measures *may* be the markers of value creation (and it seems to us that they are in many instances), they can also reflect time-inconsistent pricing paths that do not bear significantly on value creation.

Corollary 4: *When $k \geq k^*$ and the decision rule governing shareholder revolts is efficient ex post, managers in equilibrium are inefficiently attracted to long-term projects at the ex ante stage.*

This result identifies a central efficiency tension in our model between static and dynamic efficiency. As Corollary 2 demonstrated, it is possible to implement an efficient corporate governance regime at the interim stage if either (i) capital constraints do not bind ($k = \infty$) or (ii) the governance system vests control in unbiased shareholders ($\gamma = 1$). Corollary 4 states that in either case, an *ex ante* inefficiency remains in our model: managers are systematically smitten with the LT project and — by dint of their overconfidence — they too frequently embrace such projects even the actuarial shadow of a subsequent veto threat (and ensuing switching costs to revert to ST). Interestingly, if the prospect of a later veto were more greater (even due to an inefficient governance rule), the threat could neutralize M's overconfident attraction to LT.[40] This static-dynamic trade-off is captured in Corollary 5.

Corollary 5: *In the presence of both managerial overconfidence and investor present bias, a decision rule that induces some inefficient shareholder revolts ex post ($\gamma < 1$) can deter some overconfident managers from inefficiently committing the firm to inefficient long-term projects ex ante.*

Corollary 5 states an intriguing implication of our main result: that managerial overconfidence and shareholder present-bias – while both value-eroding in isolation – may counteract one another when mutually present. As explored in Lemma 5, setting $\gamma = 1$ maximizes the market value of the LT firm conditional on the choice of project. However, Corollary 4 teaches that this value maximally exacerbates the manager's tendency to favor long-term projects. If the manager's choice of γ were constrained to an upper bound whereby $\gamma \leq \bar{\gamma} < 1$, then in equilibrium the pivotal shareholder would become more present biased and the probability of a shareholder revolt would

[40] In fact, it is worth observing that M's overconfidence may do double duty in creating this ex ante inefficiency: not only does overconfidence cause her to be overly attracted to LT, but her very overconfidence leads M to embrace the efficient decision rule, presuming that an unbiased shareholder will support her in the event of a shareholder revolt. She therefore vests the pivotal vote in the unbiased equilibrium shareholder ($\beta = 1$), who proceeds (probabilistically) to turn on M through a shareholder revolt when it is later revealed that M was unduly optimistic.

increase, reducing M's payoff from the LT project. In fact, if one were certain *ab initio* that LT was value-destroying, then any $\bar{\gamma} \leq \hat{\gamma}$ (see Lemma 6) would effectively compel the manager to opt for ST (efficiently).

Although the Corollary highlights constraints on governance, similar reasoning could apply to other policy manipulations that would tend to move the pivotal vote further into the hands of a short-termist shareholder. For example, along with limiting γ, one could also constrain investors' capital constraint below some prescribed value $\bar{k}$, which would similarly vest more decision-making authority in the hands of present-biased investors. Alternatively, courts might grant their imprimatur under fiduciary duty law for director-nominees of shorter-horizon investors to privilege their own constituency's best interests in corporate deliberations — a topic that remains unsettled.[41]

We hasten to add that we do view Corollary 5 as an open invitation to policy makers to "engineer" present-bias into equilibrium prices—even in a well intentioned effort to balance static inefficiencies against dynamic ones. The precise trade-off turns on heterogeneous and difficult-to-observe characteristics, and it is plausibly model specific. Moreover, even if one could eliminate model uncertainty, the deliberate exacerbation of behavioral biases would still impose a valuation discount on all firms – a discount that could deter entrepreneurship *writ large.* By the same token, however, Corollary 5 also calls into question the reverse strategy (plausibly also well intentioned) of attempting to engineer short termism completely *out of the picture,* irrespective of whether it serves an important role in counterbalancing managerial long termism. (And vice versa.) At the very least, one would first want to determine whether short termism and long termism are likely to interact as an empirical matter, and under what circumstances. To the extent that overconfidence and present biases are coextensive (or are "matched"), an appropriate policy response may be simply to leave well enough alone. Moreover, to the extent that these phenomena tend to mutually exclusive (or are "mismatched"), an appropriate response *still* would likely be context-specific, not monolithic or categorical. (We return to this point below.)

[41] That said, prominent Delaware judges seem to have staked out an inconsistent course. See, e.g., Laster & Zeberkiewicz (2015), at 49 (arguing that all directors' fiduciary duties should be that of "maximiz[ing] the value of the corporation over the long term for the benefit of the providers of long-term (i.e., presumptively permanent) capital").

4.2 Extensions and Empirical Implications

Our analysis has concentrated on a baseline formulation of our model. From it, we have generated several insights that are of potential policy significance. Whether their significance is more than *potential*, however, depends on the robustness of these insights, both theoretically and empirically. We address each briefly in turn.

Consider first a variety of extensions one might add to the theoretical model. First, one might consider alternative permutations on how players forecast/update their respective biases. In particular, one could consider varying the degrees of "sophistication" the players in the model have about their own biases. Shareholders may be able to forecast their later susceptibility to present bias, and managers may be self-aware of their penchant for overconfidence. This possibility is intriguing within our model because market prices tend to have informational content that may reflect this sophistication and transmit information that permits one to learn about her own type in equilibrium. Allowing for shareholder sophistication is particularly important to the extent that shareholder short termism is an *induced* (rather than fundamental) preference; shareholders who are present-biased due to (say) a compensation contract will accurately predict their degree of present bias tomorrow. In terms of the model, each shareholder of type β would accurately predict that her future self would also be of type β. Introducing this form of sophistication would have interesting effects on our results. First, note that sophistication of shareholders would not change the support of equilibrium shareholders ($\{\beta|\beta \in [\beta^*, 1]\}$), nor would it change the identity of the pivotal shareholder $\left(\beta_\gamma\right)$ for any given decision rule (γ). However, sophisticated (but present-biased) investors would more steeply discount entrenching governance rules (such as $\gamma = 1$) relative to their naïve counterparts, since they fully comprehend what decisions will be valuable to them in the future (and what will not).[42] If this effect is strong enough, it can cause M to react by walking back the decision rule to some $\gamma < 1$, so as to avoid the steep pricing discount. In turn, per Corollary 4, this reaction could deter overconfident managers from inefficiently pursuing the

[42] In conventional behavioral economics settings, sophistication sometimes implies that the decision-maker will attempt to tie her own hands ex ante, to prevent her later self from acting on future prefences. When present bias is induced, however, the actor no longer values such commitment devices alone, since the induced short-termist internalizes that as a cost.

LT project. On the other hand, it may also be possible that the manager responds to sophisticated short-termists by accepting the discount insulating herself completely through a dictatorial governance structure (such as dual-class capitalizations). We leave the details of this extension for future work, but it holds obvious significance for the activism debate.

One could also extend the model to alter the probabilistic support of the players preferences – e.g., contexts in which there are known to be no unbiased agents *all* managers and/or shareholders are known to be biased. In many respects this alteration is but a special case of our model. It could nonetheless have interesting implications: one of them is that managers and shareholders may become even less trusting of one another than in the baseline case. Shareholders may be much more likely ab initio to revolt; managers, for their part, might well embrace dictatorial governance rules that allow no vetoes (such as through dual class stock), even though shareholders will disfavor such regimes and discount the stock price accordingly.

Empirically, our results suggest that efficiency-minded policy makers aspiring to intervene in the activism debate would be wise to assess whether (and how) overconfidence and present bias interact in practice. As noted above, when the two phenomena are both present, they can have counterbalancing effects, and an appropriate regulatory response may lean towards the laissez-faire. However, when overconfidence and present bias tend to occur in isolation, it could make sense to tailor regulatory/judicial policy, placing a thumb on the scale favoring activists in some contexts and favoring managers in others. This is clearly an empirical question that is largely beyond the scope of the current paper, but is the focus of a companion project to this one. (Indeed, a principal goal of this paper is to tease out – in a manner more disciplined than seat-of-the-pants conjecture – intuitions that lend themselves to empirical calibration / testing.) Although we reserve the balance of that analysis for another day, one potential strategy might be to focus on established proxies for managerial overconfidence and investor present bias, exploring their empirical relationship (1) with one another, as well as (2) with realized episodes of shareholder activism. If overconfidence and present bias are statistical complements, we would expect that *in equilibrium*, they would be positively correlated both with one another and with observed activism engagements. If they are statistical substitutes, in contrast, we would not expect to observe a positive correlation between them in equilibrium, nor would we expect both to be positively correlated with activism engagements. We hope to pursue these issues in future work.

5 Conclusion

In this paper, we have drawn inspiration from emerging literatures on managerial overconfidence and investor present bias to develop and analyze a theoretical model interacting these effects (in differential degrees) within a capital market / corporate governance setting. The equilibria generated by our model bear a striking resemblance to many of the characteristics of the heated debate currently embroiling the relative merits of hedge fund activism in public companies. Moreover, our framework has generated both prescriptive and empirical implications for this debate, many of which we plan to pursue in future work (and invite others to do the same). We remain mindful that our analysis comes nowhere close to putting this debate to rest. To the contrary: even judged on their own terms, our model's implications remain tethered to several empirical questions that (to our knowledge) remain unaswered. That said, we believe that such questions are both relevant and answer*able*, and that due consideration of them deserves a seat at the prescriptive table.

6 Appendix

Proof of Lemmas 1a and 1b: *Consider a shareholder of type δ holding fraction dx of the firm after M has chosen LT. This shareholder will favor vetoing M whenever her expected ownership stake from abandoning the project exceeds her expected payoff (equilibrium) from deferring, or:*

$$\beta\delta q\bar{\pi}V_H \cdot dx < qW_c \cdot dx \tag{17}$$

Substituting the functional form of $\bar{\pi}$ and solving for z and β (respectively) yields the result in the text.■

Proof of Lemma 2: *Suppose first that M has opted for the ST project; a potential investor of type β would assess the following valuation on the entire company:*

$$\omega_{ST} = \beta \cdot \delta qW \tag{18}$$

Suppose alternatively that M has opted for the LT project, and potential investors anticipate that the project will be vetoed with equilibrium probability $\rho(z)$. The potential investor of type β would assess the following valuation on enterprise:

$$\begin{aligned} \omega_{LT} &= E_Z\left\{\beta \cdot \delta q\left(\rho(z) W_c + (1-\rho(z))\,\delta V_H \cdot \bar{\pi}(z)\right)\right\} && (19)\\ &\geq \beta \cdot \delta qW_c && (20) \end{aligned}$$

Note that the expressions for ω_{ST} and ω_{LT} in (18) and (19) are sufficiently large that both represent expected payoffs in excess of the investment cost (I) for at least some range of potential shareholders. Consequently, so long as investment capacity of investors (reflected by k) is large enough, it will be possible to finance the project. Second, note that M has an incentive to sell to the highest valuing investors, who will pay the most (on a per share basis) for their stake. Consequently, it follows that those who purchase will exhaust their purchasing constraint limit (of k), buying as many fractional shares as possible. Accordingly, the highest valuing investors who purchase must consist of an interval from $[\beta^*, 1]$, who contribute total revenues of:

$$\int_{\beta^*}^{1} (k)\, f(\beta)\, d\beta = k \cdot (1 - F(\beta^*)). \tag{21}$$

Because the marginal shareholder is of type β^*, the market must assess an equilibrium value on the entire company of $\beta^* V_i$ (the marginal shareholder's

valuation), implying a total valuation of the public offering of:

$$(1-\alpha)\cdot\beta^{*}\omega_{i}, \tag{22}$$

for $i\in\{ST,LT\}$*. Equilibrium further requires that the marginal bidder be willing to purchase, so that total auction revenues must be weakly less than the bidder's valuation:*

$$k\cdot\left(1-F\left(\beta^{*}\right)\right)\leq(1-\alpha)\cdot\beta^{*}\omega_{i} \tag{23}$$

The manager thus wants to choose α *to maximize his expected payoff subject to the constraints that he must (a) raise sufficient capital to make the investment and (b) that the auction must clear. Whenever* $\beta^{*}<1$*, it is clear that M would prefer to set* α *as small as possible regardless of the project chosen, because investors discount all future payoffs excessively (from M's perspective). Even when* $\beta^{*}=1$ *(the limiting case when* $k\rightarrow\infty$*), M weakly prefers setting as small as possible after choosing the LT project, since all potential shareholders are no more confident about the LT project than is M. Imposing this condition implies that (23) must bind at equality, which in turn implies:*

$$(1-\alpha)=\frac{k\left(1-F\left(\beta^{*}\right)\right)}{\omega_{i}\beta^{*}} \tag{24}$$

Finally, it must be the case that the total amount raised is also equal to the investment requirement I *:*

$$\begin{aligned} I &= (1-\alpha)\cdot\beta^{*}\omega_{i} \\ &= \left(\frac{k\left(1-F\left(\beta^{*}\right)\right)}{\omega_{i}\beta^{*}}\right)\cdot\beta^{*}\omega_{i} \\ &\Leftrightarrow \quad F\left(\beta^{*}\right)=1-\frac{I}{k}<1, \end{aligned} \tag{25}$$

which identifies the value of β^{*} *uniquely as that given in the lemma:*

$$\beta^{*}=F^{-1}\left(1-\frac{I}{k}\right) \tag{26}$$

The cumulative distribution of shareholders will correspond to the right tail

of $F(\beta|\beta \geq \beta^*)$, *or:*

$$\begin{aligned} G(\beta) &= F(\beta|\beta \geq \beta^*) \qquad (27) \\ &= \frac{F(\beta) - F(\beta^*)}{1 - F(\beta^*)} \\ &= \frac{F(\beta) - \left(1 - \frac{I}{k}\right)}{\left(\frac{I}{k}\right)} \qquad (28) \\ &= \begin{cases} 1 - \frac{k}{I}(1 - F(\beta)) & \text{if } \beta \in [\beta^*, 1] \\ 0 & \text{else} \end{cases} \end{aligned}$$

which is the expression stated in the Lemma.■

Proof of Lemmas 3 & 4: *Follow directly from discussion in text.*■

Proof of Lemma 5: *From Lemma 3, we know that* $\tau = \mu = 0$, *and thus if* M *has opted for LT, it must be because she observed a good signal. That said, the likelihood that the manager has observed a good signal is increasing in managerial overconfidence* (z). *In formulating their respective valuations of the LT firm, then, investors will assess a posterior probability density on the manager's degree of overconfidence, conditional on having selected the LT project.*

$$\begin{aligned} h(z|LT) &= \frac{\Pr\{LT|z\}}{\Pr\{LT\}} h(z) \qquad (29) \\ &= \frac{\theta\pi + (1-\pi) z\theta}{\int_0^1 (\theta\pi + (1-\pi) z\theta) h(z)\, dz} \cdot h(z) \\ &= \frac{\frac{\pi}{1-\pi} + z}{\frac{\pi}{1-\pi} + E(z)} \cdot h(z) \end{aligned}$$

Note that this posterior density places greater mass on the manager's overconfidence than the unconditional density $h(z)$.

Shareholders thus know that a veto will ensue M *if they observe* $z \geq \hat{z}_\gamma$, *which occurs with probability* $\int_{\hat{z}_\gamma}^1 h(z|LT)\, dz = 1 - H(\hat{z}_\gamma|LT)$, *and they will consequently receive a payoff from the ensuing reversion to ST, which represents an ex ante value to the marginal shareholder* β^* *of:*

$$\beta^* \delta \cdot q \cdot W_c \qquad (30)$$

In contrast, shareholders will support M *if* $z < \hat{z}_\gamma$, *which occurs with probability* $H(\hat{z}_\gamma|LT)$, *and they will receive the continuation payoff from staying with LT, which represents an ex ante value to the marginal shareholder* β^* *of:*

$$\beta^* \delta^2 \cdot qV_H \cdot E\left(\bar{\pi} | z < \hat{z}_\gamma; LT\right) \tag{31}$$

where

$$\begin{aligned} E\left(\bar{\pi} | z < z^*; LT\right) &= \int_0^{\hat{z}_\gamma} \left(\frac{\frac{\pi}{(1-\pi)}}{\frac{\pi}{(1-\pi)} + z} \right) \frac{h\left(z | LT\right)}{H\left(\hat{z}_\gamma | LT\right)} dz \\ &= \int_0^{\hat{z}_\gamma} \frac{\frac{\pi}{(1-\pi)}}{\frac{\pi}{1-\pi} + E\left(z\right)} \frac{h\left(z\right)}{H\left(\hat{z}_\gamma | LT\right)} dz \\ &= \frac{\frac{\pi}{(1-\pi)}}{\frac{\pi}{1-\pi} + E\left(z\right)} \frac{H\left(\hat{z}_\gamma\right)}{H\left(\hat{z}_\gamma | LT\right)} \end{aligned} \tag{32}$$

Assembling each of these components gives rise to the implied market valuation of the LT firm for a given value of γ*:*

$$\begin{aligned} \omega_{LT}\left(\gamma\right) &= \left[1 - H\left(\hat{z}_\gamma | LT\right)\right] \cdot \beta^* \delta \cdot qW_c \\ &\quad + H\left(\hat{z}_\gamma | LT\right) \cdot \beta^* \delta^2 \cdot qV_H \cdot E\left(\bar{\pi} | z < \hat{z}_\gamma; LT\right) \\ &= \left[1 - H\left(\hat{z}_\gamma | LT\right)\right] \cdot \beta^* \delta \cdot qW_c \\ &\quad + H\left(\hat{z}_\gamma | LT\right) \cdot \beta^* \delta^2 \cdot qV_H \cdot \left(\frac{\frac{\pi}{(1-\pi)}}{\frac{\pi}{1-\pi} + E\left(z\right)} \frac{H\left(\hat{z}_\gamma\right)}{H\left(\hat{z}_\gamma | LT\right)} \right) \\ &= \left[\int_{\hat{z}_\gamma}^1 \frac{\frac{\pi}{1-\pi} + z}{\frac{\pi}{1-\pi} + E\left(z\right)} \cdot h\left(z\right) dz \right] \cdot \beta^* \delta \cdot qW_c \\ &\quad + \left[\int_0^{\hat{z}_\gamma} h\left(z\right) dz \right] \cdot \beta^* \delta^2 \cdot qV_H \cdot \left(\frac{\frac{\pi}{(1-\pi)}}{\frac{\pi}{1-\pi} + E\left(z\right)} \right) \\ &= \frac{\beta^* \delta \cdot q}{\frac{\pi}{1-\pi} + E\left(z\right)} \left(\begin{array}{c} W_c \cdot \left(\frac{\pi}{1-\pi}\right) \cdot \int_{\hat{z}_\gamma}^1 h\left(z\right) dz \\ + W_c \cdot \int_{\hat{z}_\gamma}^1 z h\left(z\right) dz + \delta V_H \cdot \left(\frac{\pi}{1-\pi}\right) \cdot \int_0^{\hat{z}_\gamma} h\left(z\right) dz \end{array} \right) \\ &= \frac{\beta^* \delta \cdot q}{\frac{\pi}{1-\pi} + E\left(z\right)} \cdot W_c \cdot \left(\begin{array}{c} \left(\frac{\pi}{1-\pi}\right) + \left(\frac{\delta V_H - W_c}{W_c}\right) \cdot \left(\frac{\pi}{1-\pi}\right) \cdot H\left(\hat{z}_\gamma\right) \\ + E\left(z | z \geq \hat{z}_\gamma\right) \cdot \left(1 - H\left(\hat{z}_\gamma\right)\right) \end{array} \right) \end{aligned} \tag{33}$$

which is the expression given in expression (12) of the Lemma.

To show that the optimal governance structure is given by $\gamma = 1$*, recall that there is a one-to-one relationship between* γ, β_γ *and* $\hat{z}_\gamma$*, and consider the*

optimal choice of $\hat{z}_\gamma$*. Differentiating* ω_{LT} *with respect to* γ *yields:*

$$\begin{aligned}\frac{\partial \omega_{LT}}{\partial \hat{z}_\gamma} &= \frac{\beta^* \delta \cdot q \cdot W_c}{\frac{\pi}{1-\pi}+E(z)}\left(\left(\frac{\delta V_H - W_c}{W_c}\right)\left(\frac{\pi}{1-\pi}\right)\cdot \frac{\partial}{\partial \hat{z}_\gamma} H\left(\hat{z}_\gamma\right) + \frac{\partial}{\partial \hat{z}_\gamma}\int_{\hat{z}_\gamma}^{1} dH\left(z\right)\right) \quad (34)\\ &= \frac{\beta^* \delta \cdot q \cdot W_c}{\frac{\pi}{1-\pi}+E(z)} h\left(\hat{z}_\gamma\right)\cdot\left[\left(\frac{\delta V_H - W_c}{W_c}\right)\left(\frac{\pi}{1-\pi}\right) - \hat{z}_\gamma\right]\end{aligned}$$

Note that the multiplicative term outside the square brackets is strictly positive, but the term inside the square brackets changes from positive to negative at $\hat{z}_\gamma = \left(\frac{\delta V_H - W_c}{W_c}\right)\left(\frac{\pi}{1-\pi}\right)$*, signifying a maximum. Substituting in the definition of* $\hat{z}_\gamma$ *yields:*

$$\begin{aligned}\hat{z}_\gamma &= \left(\frac{\delta V_H - W_c}{W_c}\right)\left(\frac{\pi}{1-\pi}\right) \quad (35)\\ \left(\frac{F^{-1}\left(1-\frac{I}{k}(1-\gamma)\right)\delta V_H - W_c}{W_c}\right)\cdot\left(\frac{\pi}{1-\pi}\right) &= \left(\frac{\delta V_H - W_c}{W_c}\right)\left(\frac{\pi}{1-\pi}\right)\\ F^{-1}\left(1-\frac{I}{k}\left(1-\gamma\right)\right) &= 1\\ 1-\frac{I}{k}\left(1-\gamma\right) &= F\left(1\right)\\ \frac{I}{k}\left(1-\gamma\right) &= 0\end{aligned}$$

This expression is uniquely satisfied at $\gamma = 1$ *for any value of* k*. In the limiting case where there are no capital constraints bind and* $k \to \infty$*, the expression is satisfied for all values of* γ*. Imposing* $\hat{z}_1 = \left(\frac{\delta V_H - W_c}{W_c}\right)\left(\frac{\pi}{1-\pi}\right)$ *on (12) and then rearranging yields expression (13)*■

Proof of Lemma 6. *If M pursues ST, then as noted above she will incur dilution equal to* $(1-\alpha_{ST}) = \frac{I}{\omega_{ST}}$*, culminating in an expected net payoff of* $\alpha_{ST}\cdot\frac{\omega_{ST}}{\beta^*} = \frac{\omega_{ST}-I}{\beta^*}$*. If she pursues LT after a good signal, in contrast, she will incur dilution of* $(1-\alpha_{ST}) = \frac{I}{\omega_{ST}(\gamma)}$*. M's expected payoff net payoff from LT is somewhat more complicated, because an overconfident M values LT more highly than even the least biased shareholder. Indeed, in a B-T Equilibrium, the manager dismisses the possibility that she is receiving an inaccurate signal, and she instead presumes her signal to be perfectly precise. Moreover, she is certain that when shareholders later observe her degree of overconfidence, they will discover that she is perfectly rational (*$z = 0$*). Thus, from the manager's perspective, shareholders will revolt against her only if the*

pivotal shareholder (β_γ) would systematically oppose any manager, regardless of overconfidence. This would happen only if and only if:

$$\begin{aligned} \beta_\gamma &\leq \hat{\beta}(0) = \frac{W_c}{\delta V_H} \\ \gamma &\leq \gamma^* \equiv Max\left\{0, 1 - \frac{k}{I}\left(1 - F\left(\frac{W_c}{\delta V_H}\right)\right)\right\} < 1 \end{aligned} \tag{36}$$

This is the condition stated in the Lemma.■

Proof of Proposition 1: *All of the Proposition follows immediately from Lemmas 1-6, save the condition on k^* and the optimality for M of setting $\gamma = 1$ for the LT project. Beginning with the latter, suppose not and that the optimal governance of the LT project from M's perspective were at $\gamma < 1$. From Lemma 5, we know that this corresponds to a value of $\hat{z}_\gamma < \left(\frac{\delta V_H - W_c}{W_c}\right)\left(\frac{\pi}{1-\pi}\right)$. However, by increasing $\hat{z}_\gamma$, (34) implies that the market value of LT will increase, resulting in a smaller dilution per expression (), and (because $\gamma = 1 > \hat{\gamma}$) a lower perceived probability of a shareholder veto. This implies a contradiction.*

To show the condition on k^*, we first fix $\gamma = 1$, which is its optimal value from M's perspective. At this point, M believes (wrongly) that her preferences are perfectly aligned with the type $\beta = 1$ investor, and she will never be vetoed. Consequently M's perceived payoff at this stage consists of (i) the payoff she anticipates of the LT project (conditional on a good signal), discounted by (ii) the market dilution M must accept to finance the project. The manager's expected net payoff is thus:

$$\begin{aligned} \alpha_{LT} \cdot \delta^2 q V_H &= \left(1 - \frac{I}{\omega_{ST}(1)}\right) \cdot \delta^2 q V_H \\ &= \left(1 - \frac{I}{\beta^* \delta q W_c \cdot \left(\frac{\left(\frac{\pi}{1-\pi}\right) + E\left(\max\left\{z, \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right)\right\}\right)}{\frac{\pi}{1-\pi} + E(z)}\right)}\right) \cdot \delta^2 q V_H \\ &= \delta^2 q V_H - \frac{I}{\beta^*} \cdot \left(\frac{\frac{\pi}{1-\pi} + E(z)}{\frac{\pi}{1-\pi} + \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)}\right) \end{aligned} \tag{37}$$

And thus, assuming M sets $\gamma = 1$, M will select the LT if and only if:

$$
\begin{aligned}
\delta qW - \frac{I}{\beta^*} &\leq \delta^2 qV_H - \frac{I}{\beta^*} \cdot \left(\frac{\frac{\pi}{1-\pi} + E(z)}{\frac{\pi}{1-\pi} + \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)} \right) \\
\beta^* &\geq \frac{I}{\delta q \left(\delta V_H - W\right)} \cdot \left(\frac{E(z) - \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)}{\frac{\pi}{1-\pi} + \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)} \right) \\
1 - \frac{I}{k} &\geq F\left(\frac{I \cdot \left(E(z) - \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)\right)}{\delta q(\delta V_H - W) \cdot \left(\frac{\pi}{1-\pi} + \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)\right)} \right) \\
k &\geq \frac{I}{1 - F\left(\frac{I \cdot \left(E(z) - \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)\right)}{\delta q(\delta V_H - W) \cdot \left(\frac{\pi}{1-\pi} + \frac{W_c}{\delta V_H} \cdot E\left(\max\left\{z - \left(\frac{\pi}{1-\pi}\right)\left(\frac{\delta V_H - W_c}{W_c}\right), 0\right\}\right)\right)} \right)}
\end{aligned} \tag{38}
$$

which is the expression given in the Proposition.■

7 References

1. Allaire, Yvon & Francois Dauphin, "Hedge Fund Activism: Preliminary Results and Some New Empirical Evidence" (Institute for the Governance of Public and Private organizations, April 1, 2015).

2. Allison, Paul D. (2009) Fixed Effects Regression Models (Sage Publications).

3. Armor, D., and S. Taylor. 2002. When predictions fail: The dilemma of unrealistic optimism.

4. Baker, M. P., & Wurgler, J. (2013). Behavioral Corporate Finance: An Updated Survey, in Constantinides, G., Harris, M., & Stulz, R. (Eds.), Handbook of the Economics of Finance (Volume 2).

5. Bamber, Linda; Koo, David; Yeung, P. Eric. "Managers' Forecasts of Long-Term Growth in Earnings: New Information or Wishful Thinking?" (Working paper 2015).

6. Banerjee, Suman, Mark Humphery-Jenner, and Vikram Nanda (2015). Restraining Overconfident CEOs through Improved Governance: Evidence from the Sarbanes-Oxley Act 28 Rev. Financ. Stud. 2812.

7. Bebchuk, Lucian A. and Brav, Alon and Jackson, Robert J. and Jiang, Wei, 2013. Pre-Disclosure Accumulations by Activist Investors: Evidence and Policy (April 2013). Journal of Corporation Law, Vol. 39, No. 1, pp. 1-34.

8. Bebchuk, Lucian, Alon Brav and Wei Jiang.The Long-Term Effects of Hedge Fund Activism, Columbia Law Review, Volume 114, June 2015.

9. Ben-David, Itzhak, John Graham, Cam Harvey, 2013. Managerial Miscalibration,128 Q. J. Econ. 1547-__.

10. Ben-David, Itzhak, Francesco Franzoni, and Rabih Moussawi, 2012, Hedge Funds Stock Trading during the Financial Crisis of 2007-2009, Review of Financial Studies 25(1), 1–54

11. Benhabib, Jess, Alberto Bisin & Andrew Schotter, 2010. Present-bias, quasi-hyperbolic discounting, and fixed costs. Games and Economic Behavior 69(2): 205–223.

12. Bloomfield, R. and J. Luft. 2006. Responsibility for Cost Management Hinders Learning to Avoid the Winner's Curse. The Accounting Review 81(1), 29-47.

13. Bolton, Patrick, Jose Scheinkman and Wei Xiong, 2006. Executive Compensation and Short-Termist Behaviour in Speculative Markets, Review of Economic Studies, 73: 577–610.

14. Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer. 2012. "Salience Theory of Choice Under Risk." Quarterly Journal of Economics 127 (3): 1243-1285.

15. Braithwaite, Tom, 2015. Tech 'Unicorns' Opt for Dual Share Listings. Financial Times (October 16, 2015).

16. Brav A, Jiang W, Partnoy F, Thomas R. 2008. Hedge fund activism, corporate governance, and firm performance. J. Finance. 63(4), 1729–75.

17. Brunnermeier, Markus K, and Stefan Nagel. "Hedge Funds and the Technology Bubble". The Journal of Finance 59 (2004): 2013-2040.

18. Bushee, B., J., 1998, The Influence of Institutional Investors on Myopic R&D Investment Behavior, Accounting Review 73, 305-333.

19. Bushee, B., J., 2001, Do Institutional Investors Prefer Near Term Earnings of Long Time Value, Contemporary Accounting Research 18, 207-246.

20. Brav, Alon, Wei Jiang and Hyunseob Kim, The Real Effects of Hedge Fund Activism: Productivity, Asset Allocation, and Labor Outcomes," Review of Financial Studies (2015a).

21. Brav, Alon, Wei Jiang and Hyunseob Kim, Recent Advances in Research on Hedge Fund Activism: Value Creation and Identification," Annual Review of Financial Economics, (2015b).

22. Bubb, Ryan & Richard Pildes, 2014. How Behavioral Economics Trims Its Sails, and Why, Harvard Law Review 127:1593-1678.

23. Cadman, Brian D. and Rusticus, Tjomme O. and Sunder, Jayanthi (2013), Stock Option Grant Vesting Terms: Economic and Financial Reporting Determinants, Review of Accounting Studies 18:4, pp 1159-1190.

24. Camerer, C. & Lovallo, D. (1999). Overconfidence and excess entry: An experimental approach. American Economic Review, 89, 306–318.

25. Camerer C. & Talley, E. (2007). Experimental Study of Law, in Handbook of Law and Economics, Vol. 2, Ch. 21 (A. Mitchell Polinsky & Steven Shavell, eds.).

26. Campbell, T. C., M. A. Gallmeyer, S. A. Johnson, J. Rutherford, and B. W. Stanley. 2011. CEO optimism and forced turnover. Journal of Financial Economics 101:695-712.

27. Chen, G, Crossland, C. & Luo, S.* "Making the same mistake all over again: CEO overconfidence and corporate resistance to corrective feedback". Forthcoming at Strategic Management Journal, in press online at DOI: 10.1002/smj.2291

28. Coffee, John C. and Darius Palia, The Wolf at the Door: The Impact of Hedge Fund Activism on Corporate Governance, September 4, 2015.

29. Conference Board, 2015. Is Short-Term Behavior Jeopardizing the Future Prosperity of Business?

30. Cremers, M., E. Giambona, Simone Sepe, and Y. Wang, 2015. Hedge Fund Activism and Firm Value (working paper)

31. Cyert, Richard M. Morris H. DeGroot, &Charles A. Holt. Capital Allocation within a Firm Behavioral Science, September 1979, 24(5), 287-295.

32. Deshmukh, S., A. M. Goel, and K. M. Howe, 2013, CEO Overconfidence and Dividend Policy, Journal of Financial Intermediation, 22: 440-463.

33. Froot, K., and E. Dabora, 1999. How are stock prices affected by the location of trade? Journal of Financial Economics 53:189-216.

34. Gestein, Alan, , Bradley C. Faris, Timothy P. FitzSimons, and John M. Newell, 2014, Hushmail: Are Activist Hedge Funds Breaking Bad? Harvard Corporate Governance Blog (July 7, 2014).

35. Gillette Ann B., Thomas H. Noe & Michael J. Rebello, Corporate Board Composition, Protocols, and Voting Behavior: Experimental Evidence The Journal of Finance Volume 58, Issue 5, pages 1997-2032, October 2003.

36. Gilovich, T., M. Kerr, and V. Medvec. 1993. The effect of temporal perspective on subjective confidence. Journal of Personality and Social Psychology 64 (4): 552-560.

37. Graham, John, Campbell Harvey, & Manju Puri, 2010, Managerial attitudes and corporate actions, Journal of Financial Economics, 2013, 109:1, 103-121.

38. Greenwood, Robin & Michael Schor, 2009. Investor activism and takeovers. J. Fin. Econ. 92:362–375.

39. Hall, B. and Murphy, K. J., 'Stock options for undiversified executives', Journal of Accounting and Economics, Vol. 33, 2002, pp. 3–42.

40. Hardisty, David J., Kirstin C. Appel & Elke U. Webber, 2012. Good or Bad, We Want it Now: Fixed-cost Present Bias for Gains and Losses

Explains Magnitude Asymmetries in Intertemporal Choice. J. Behav. Dec. Making __-__.

41. Hausman, Jerry, Hall, Bronwyn H. and Griliches, Zvi (1984.) "Econometric models for count data with an application to the patents-R&D relationship." Econometrica, 52: 909-938.

42. Heaton, J. B., 'Managerial optimism and corporate finance', Financial Management, Vol. 31, 2002, pp. 33–45. Hey, J. D., 'The economics of optimism and pessimism', Kyklos, Vol. 37, no. 2, 1984, pp. 181–205.

43. Hribar, Paul and Holly Yang, CEO Overconfidence and Management Forecasting, Contemporary Accounting Research, 2015 - Publication Details (Forthcoming).

44. Humphery-Jenner. M, Ling Lei Lisic, Vikram Nanda, & Sabatino Dino Silverie (2016), Executive overconfidence and compensation structure. Journal of Financial Economics (forthcoming).

45. Kolasinski, A. C., and X. Li. 2013. Do Strong Boards and Trading in Their Own Firm's Stock Help CEOs Make Better Decisions? Evidence from Corporate Acquisitions by Overconfident CEOs. Journal of Financial and Quantitative Analysis 48:1173.

46. Kreps, David M. and Robert Wilson, 1982. "Sequential Equilibria," Econometrica 50:863-894.

47. Krishan, C.N.V., Partnoy F, Thomas R., 2015. The Second Wave of Hedge Fund Activism: The Importance of Reputation, Clout, and Expertise (working paper).

48. Kruger, J., 'Lake Wobegon be gone! The 'below-average effect' and the egocentric nature of comparative ability judgments', Journal of Personality and Social Psychology, Vol. 77, no. 2, 1999, pp. 221–32.

49. Landier, A. and Thesmar, D., Financial Contracting with Optimistic Entrepreneurs: Theory and Evidence, Review of Financial Studies (2009).

50. Langer, E. J., 'The illusion of control', Journal of Personality and Social Psychology, Vol. 32, 1975, pp. 311–28.

51. Larwood, L., and W. Whittaker. 1977. Managerial myopia: Self-serving biases in organizational planning. Journal of Applied Psychology 62 (2): 194-8.

52. Laster, J. Travis and John Mark Zeberkiewicz, 2015. The Rights and Duties of Blockholder Directors. Business Lawyer 70: 33-60.

53. Lim, Jongha, Berk A. Sensoy & Michael S. Weisbach, 2015. Indirect Incentives of Hedge Fund Managers, Journal of Finance (forthcoing).

54. Lipton, Martin, 2013. Empiricism and Experience; Activism and Short-Termism; the Real World of Business, Harvard Corporate Governance Blog.

55. Liu, Xuewen & Antonio S. Mello (2011). The fragile capital structure of hedge funds and the limits to arbitrage, Journal of Financial Economics, 102:3 pp 491–506.

56. Malmendier, Ulrike and Geoffrey Tate, 2005a, CEO Overconfidence and Corporate In- vestment, The Journal of Finance 60, 2661–2700.

57. Malmendier, Ulrike and Geoffrey Tate, 2005b, Does Overconfidence Affect Corporate Investment? CEO Overconfidence Measures Revisited, European Financial Management, November 2005, vol. 11 (5), pp. 649-659.

58. Malmendier, U., and G. Tate. 2008. Who Makes Acquisitions? CEO Overconfidence and the Market's Reaction. Journal of Financial Economics 89:20-43.

59. Malmendier, U., G. Tate, and J. Yan. 2011. Overconfidence and Early-Life Experiences: The Effect of Managerial Traits on Corporate Financial Policies. Journal of Finance 66:1687.

60. McGurk, Jamie, Stephen McDermid, Vishal Amin and Irvin Chan, 2015. Making Sense of the Dell-EMC Deal, Fortune.com (October 27, 2015).

61. Nisbett, R. E. and Ross, L., Human Inference: Strategies and Shortcomings of Social Judgment (Engiewood Cliffs NJ: Prentice-Hall, 1980).

62. Roe, Mark, 1994. Strong Managers, Weak Owners: The Political Roots of American Corporate Finance at 242-43.

63. Porter, Michael, 1992. Capital disadvantage: America's failing capital investment system, Harv Bus Rev. 70(5):65-82.

64. Sen, Rik and Tumarkin, Robert, 2015. Stocking Up: Executive Optimism, Option Exercise, and Share Retention. Journal of Financial Economics, 118:2 2015

65. Shefrin, Hersh M. & Statman, Meir, 1984. Explaining investor preference for cash dividends, Journal of Financial Economics 13(2): 253–282.

66. Shepperd, J. A., Ouellette, J. A., & Fernandez, J. K. (1996). Abandoning unrealistic optimism: Performance estimates and the temporal proximity of self-relevant feedback. Journal of Personality and Social Psychology, 70, 844-855.

67. Shleifer, Andrei, 2000. Inefficient Markets: An Introduction to Behavioral Finance (Oxford University Press).

68. Shleifer, Andrei, and Robert W Vishny. 1997. "The Limits of Arbitrage." Journal of Finance 52 (1): 35-55.

69. Shleifer, Andrei, and Robert W Vishny. 1990. "Equilibrium Short Horizons of Investors and Firms." American Economic Review Papers and Proceedings 80 (2): 148-153.

70. Sozou, P. D. (1998). "On hyperbolic discounting and uncertain hazard rates". Proceedings of the Royal Society B Biological Sciences 265 (1409): 2015.

71. Stein, Jeremy C., 1989. Efficient capital markets, inefficient firms: A model of myopic corporate behavior, Quarterly Journal of Economics 104, 655-669.

72. Stein, Jeremy C. 2005. "Why Are Most Funds Open-End? Competition and the Limits of Arbitrage." Quarterly Journal of Economics 120 (1): 247-272.

73. Svenson, O., 1981. Are we all less risky and more skillful than our fellow drivers? Acta Psychologica, Vol. 47, pp. 143–48.

74. Talley, Eric L., 2015. Corporate Inversions and the Unbundling of Regulatory Competition, 101 Va. L. Rev. 1649-1751.

75. Thaler, Richard, 1981, Some empirical evidence on dynamic inconsistency. Economics Letters, 8, 201–207.

76. Weinstein, N. D., 'Unrealistic optimism about future life events', Journal of Personality and Social Psychology, Vol. 39, 1980, pp. 806–20.

8 Post-Closing-Credits Shawarma[43]

As discussed in Section 5, several prescriptive implications of our analysis turn on identifying whether managerial short-termism and investor present-bias tend to occur in isolation or in conjunction. To the extent it is the latter, they can plausibly dampen each others' effects without an extra boost from legal policy (Corollary 5). On the other hand, if the biases tend to be negatively related, appropriately calibrated legal / regulatory interventions can potentially help to address inefficient long-termism or inefficient short-termism. One strategy for exploring this question focuses on analyzing available proxies for managerial overconfidence and investor present bias, and exploring their empirical relationship (1) with one another, as well as (2) with realized episodes of shareholder activism. If overconfidence and present bias are statistical complements, we would expect that in equilibrium, they would be positively correlated with one another as well as with observed activism engagements. If they are statistical substitutes, we would not expect to observe a positive correlation between them in equilibrium, nor would we expect *both* to be positively correlated with activism engagements.

A tentative analytic sortie along these lines is reflected in Tables A1 and A2, which explore a part of the diagnostic proposition stated above. The tables summarize (A1) and then analyze in a series of regressions (A2) an unbalanced panel spanning the years 1999-2015, in which we merge Compustat data, 13D filing data (from AuditAnalytics), and one recently-developed metric of managerial overconfidence due to Sen & Tumarkin (2015). Their overconfidence metric (Share_Retainer) is a dummy variable indicating whether a CEO retained a any stock from her exercised options (versus immediately selling) in a given year. The three-way merge allows us to match the Sen & Tumarkin (2015) data with financial controls (including assets, revenues, ROA, and R&D expenditures), as well as Schedule 13D filings. We consider four left-hand-side measures of activism[44]: (a) Whether the issuer had any 13D filings during the firm-year (Filed13D_Any); (b) How many 13Ds were filed during the firm-year (Filed13D_Total); (c) Whether the issuer had any 13D filings during the firm-year where the filer specifically discloses disagreement with / criticism of management or manifests a hostile intent

[43] See https://youtu.be/EYiZeszLosE. We include this coda to outline some preliminary thoughts (for a follow-on project) related to the empirical implications of our argument.

[44] We count amended filings as separate filings, which plausibly captures the intensity of an egagement; of course, there can be some reasons to exclude amended filings as well.

to effect control (ActivistTag_Any); and (d) How many 13D filings occurred during the firm-year where the filer specifically discloses disagreement with / criticism of management or manifests an intent to effect control (ActivistTag_Total).

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
Years	17				1999	2015
Firms	6217					
Share_Retainer	54,262	0.098504	0	0.297997	0	1
Filed13D_Any	54,262	0.181306	0	0.385275	0	1
Filed13D_Total	54,262	0.498415	0	1.56713	0	46
Filed13D_Total (if >0)	9,838	2.749034	2	2.712764	1	46
ActivistTag_Any	54,262	0.040655	0	0.197491	0	1
ActivistTag_Total	54,262	0.075228	0	0.495849	0	16
ActivistTag_Total (if >0)	2,206	1.850408	1	1.66253	1	16
Total Assets ($MM)	8,863	20021.83	2762.036	102307.3	0.088	2265792
ROA	7,633	0.135973	0.138473	0.201192	-9.56903	1.243577
Revenues ($MM)	8,862	8284.213	1931.936	24410.22	-4210.2	467231
R&D as % Revenues	4,555	0.291047	0.023976	6.62255	0	305.3962

Table A1: Summary Statistics. Share_Retainer is a measure of managerial overconfidence developed by Sen & Tumarkin (2015), and is equal to 0 if the CEO sold all stock obtained on option exercise during the year and 1 otherwise. Filed13D_Any and Filed13D_Total refer, respectively, to (i) an indicator as to whether any 13Ds filed naming the issuer in a year, and (ii) how many 13Ds were filed. ActivistTag_Any and ActivistTag_Total are similar, but they are limited to 13D disclosures that are specifically hostile to the board and/or management. Data are drawn from Compustat, AuditAnalytics, and Robert Tumarkin's website.

Results from a (very) preliminary set of regressions are reproduced in Table A2, both without and with financial controls.[45] The Table reports the estimated coefficients of fixed-effect linear probability specifications for Filed13D_Any and ActivistTag_Any, and of conditional fixed-effect negative binomial specifications for Filed13D_Total and ActivistTag_Total.[46] These results suggest of a *negative* statistical relationship between managerial optimism and activist-related 13D filings. Should such a pattern persist against a variety of (yet-to-be-performed) robustness checks, it would be consistent with an argument that managerial overconfidence and investor present bias are mismatched statistical substitutes. In turn, such a finding (if it held up) might suggest that courts and regulators should be somewhat activist

[45] Including financial controls significantly reduces our sample size, an artifact of missing observations in the merging process.

[46] See Hausman, Hall & Griliches (1984). Given some documented oddies associated with this approach (e.g., Allison 2009), we re-ran a random effects specification, obtaining similar results.

themselves, digging a little deeper to unpack which effect predominates in a given case (or class thereof).

	Filed13D_Any			Filed13D_Total			ActivistTag_Any			ActivistTag_Total		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Share_Retainer	-0.0373	-0.0125	-0.0152	-0.2802	-0.0939	-0.1776	-0.0175	-0.0140	-0.0101	-0.5669	-0.5176	-0.5949
	*-4.70***	*-1.0200*	*-1.0700*	*-6.21***	*-1.1600*	*-1.5700*	*-3.98***	*-1.99***	*-1.2600*	*-5.64***	*-2.81***	*-2.12***
Ln(Assets)		0.0330	0.0149		0.1449	0.1188		0.0172	0.0124		0.3165	0.6215
		1.3700	*0.5500*		*1.8300*	*0.9500*		*1.4100*	*0.9900*		*1.6100*	*1.66**
ROA		-0.0398	0.0003		-0.6204	-0.1878		-0.0266	-0.0227		-2.6870	-2.6138
		-0.7200	*0.0100*		*-2.00***	*-0.6600*		*-1.68**	*-1.85**		*-2.28***	*-1.5000*
Ln(Revenues)		-0.0371	-0.0179		-0.2040	-0.1210		0.0026	0.0079		-0.0274	-0.0808
		-1.5600	*-0.6900*		*-2.43***	*-0.9900*		*0.2300*	*0.6100*		*-0.1400*	*-0.2200*
R&D as % of Revenues			0.0009			0.0022			-0.0002			-2.0747
			0.7300			*0.3800*			*-0.6500*			*-1.3800*
N(Obs)	54,262	7,632	4,550	30,656	3,175	1,710	54,262	7,632	4,550	14,512	1,382	710
N(Groups)	6,217	1,118	687	2,932	406	234	6,217	1,118	687	1,241	168	93
R-sqd (within)	0.0006	0.0018	0.0013				0.0004	0.0033	0.0031			
R-sqd (overall)	0.0011	0.0022	0.0015				0.0004	0.0006	0.0009			
Wald (χ-sqd)				38.54***	15.49***	5.52				31.77***	20.33***	15.45***
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A2: DepVars are four categories of 13D Filing activity (Filed13D_Any, Filed13D_Total, ActivistTag_Any, ActivistTag_Total); Share_Retainer is a measure of managerial overconfidence developed by Sen & Tumarkin (2015), and is equal to 0 if the CEO sold all stock obtained on option exercise during the year and 1 otherwise. Indicator regressions estimate fixed-effect linear probability models with robust standard errors. Count regressions estimate conditional fixed-effect negative binomial specifications. T/z-statistics in italics; ***=Significant at the 0.01 level; ** = Significant at the 0.05 level; * = Significant at the 0.10 level

We readily concede that these results are but the tip of a (potentially enormous) empirical iceberg, and additional interrogation is surely needed. Does this statistical tendency persist with alternative (possibly more nuanced) measures of managerial overconfidence[47]? Are estimated coefficients confounded by endogeneity bias, since the decision to retain shares from exercised options is plausibly connected to expectations of activism[48]? Do the results hold up against more tailored metrics for activism (e.g., engagements where the filer is a recognized activist hedge fund)? How does the inclusion of statistical proxies for short termism (e.g., Bushee 1998; 2001) interact with these results? All these questions are important, but all must wait for another day (and another paper).

[47] See, e.g., Humphrey-Jenner et al (2016) for a collection of alternative optimism proxies, including other options-holding proxies as well as news coverage metrics.

[48] Although endogeneity bias confounds much of—if not most of—empirical corporate finance, it is perhaps worth noting that that the hypotheses we formulate above reflect *equilibrium predictions* from our reduced form model. This may help mollify some concerns around identification strategy (at least to the extent our model is correctly specified and appropriate controls included).