Wolf Pack Activism *

Alon Brav† Amil Dasgupta‡ Richmond Mathews§

This version: November 2015

Abstract

It is alleged that institutional investors coordinate with each other when intervening in a target firm, with one acting as the "lead" activist and others as peripheral activists, or "wolf pack" members. We present a model of wolf pack activism. Our model formalizes a source of complementarity across the engagement strategies of activists and highlights the catalytic role played by the lead activist. We also characterize share acquisition by wolf pack members and the lead activist, providing testable implications on ownership and price dynamics in wolf pack formation.

*We are grateful to Ulf Axelson, Slava Fos, Ernst Maug, Dimitri Vayanos and audience members at Bocconi, FIRS 2015, the Future of Research on Hedge Fund Activism Conference 2015, George Mason, HKUST, LSE, Oxford Said Business School, Rotterdam, and Tilburg for helpful comments. Dasgupta thanks the Paul Woolley Centre at the LSE for financial support, and the Cambridge Endowment for Research in Finance for hospitality.

†Duke and NBER

‡London School of Economics, CEPR, and ECGI

§University of Maryland, College Park

1 Introduction

There is growing recognition that institutional shareholder activists do not intervene alone, but act in groups that enable them to magnify each other's influence over management. Activist hedge funds are leading examples. These funds are widely attributed with creating fundamental change (Brav et al 2008, Klein and Zur 2009), often in the face of hostile managers, while typically owning only around 6% of the company's shares (Brav, Jiang, and Kim 2010). In explaining the disproportionate influence of such relatively small block holders, market observers have alleged that activist hedge funds implicitly team up with other institutional investors to form so-called activist "wolf packs" (e.g., Briggs 2006, Coffee and Palia 2015). The term wolf packs has even been recognized by U.S. courts, which have implicitly acknowledged the efficacy of this tactic by upholding the use of unconventional measures undertaken by corporations to defend against it.[1] The use of the wolf pack tactic appears to have intensified in recent years, and 2014 has been described by a prominent commentator as "the year of the wolf pack" (Lipton 2015).

Despite the prominence of wolf packs and the importance of activist hedge funds in shareholder activism, there is no theoretical analysis of such phenomena. In this paper we present the first model of wolf pack activism. We model activism in a target firm by many investors: One large investor and many small ones. Our large investor is intended to represent an activist hedge fund (e.g., Pershing Square or TCI) which crosses the 5% ownership threshold and files a 13D. Our small investors may be other hedge funds—activist or otherwise—with smaller stakes or other types of institutional investors (e.g., event-driven mutual funds) who may provide support to the lead activist via voting or other forms of soft, "behind the scenes" engagement (McCahery, Sautner, and Starks 2014). These institutions play principally a smaller, supporting role in the activism process, and we refer to them throughout as small institutions for short.

[1] Third Point LLC vs Ruprecht, 2014.

Our model consists of two main components. The first is a static model of activism which focuses on the interplay of engagement strategies across the lead activist and small institutions. A key contribution of this component is to provide a theoretical foundation for complementarity across institutional investors in group activism: Without some source of complementarity, group activism would be irrelevant. Further, our engagement model highlights the catalytic effect of a lead activist on the strategies of small institutions. The second component of our model provides a dynamic characterization of block building which anticipates the coordinated activism process, and traces how small institutions and the lead activist anticipate each others' actions in making their acquisition decisions.

We start our analysis with the activism stage, taking ownership stakes as given. At this stage, each owner must decide whether to "engage" the target, i.e., exert influence (through talking with management, proposing new actions, voting, etc.) to try to improve the firm's decisions, and hence its value. Activism is successful in raising firm value if the measure of ownership that chooses to engage is sufficient to deliver value enhancement given the target firm's fundamentals. Engagement requires time and effort. For group activism to be salient, there must be complementarity between different owners: The potential engagement of others must encourage each owner to engage. This requires the existence of some excludable benefit from participation in activism: If share price appreciation—a non-excludable benefit—is the sole source of benefits to activists, then engagement by others actually *discourages* engagement. This is because, if sufficiently many others engage, then engagement succeeds and security benefits accrue to each owner regardless of engagement, a standard free rider problem. While private benefits from successful activism (e.g., via board seats acquired during a proxy fight) are apparent for the lead activist, the existence of excludable rents is less obvious for small institutions.

We model such excludable benefits via a reputational mechanism: Our small institutions are money managers who care about being viewed as skilled by their investors. Some of them are skilled and have access to valuable information that enables them to understand target firms and generate returns while others are unskilled. Institutions are unsure of their level of skill, but may discover it by acquiring shares in the target, after which they observe target fundamentals if and only if they are skilled. Potential investors observe the engagement choices of each institution as well as the overall engagement outcome and make inferences about ability. Sufficient improvements in perceived ability generate excludable rents to small institutions, which can be thought of as additional capital inflow received from impressed investors. Since reputation for skill is an equilibrium quantity, these rents are *endogenous*. We show that, in the unique equilibrium, reputational rents arise *only* from participating in a *successful* activism campaign. The key reason is that, in equilibrium, institutions who discover themselves to be unskilled never engage target management, and thus it is only possible to stand out from the crowd by engaging. Engagement, in turn, delivers reputational rewards only in the case in which activism succeeds.

Our model of activism also demonstrates that the presence of a lead activist can have a catalytic effect on engagement. We show that, holding the aggregate size of skilled institutional holdings constant, the presence of a large lead activist improves the level of coordination and leads to value-increasing engagement more often. An implication of this result is that, even when a significant number of shares are held by potential small activists, the arrival of a "lead" activist who holds a larger block may be a necessary catalyst for a successful campaign, which is consistent with the activist strategies that are well documented in the empirical literature. A related catalytic effect of a large player in a coordination game has been shown to arise in the context of speculative currency attacks by Corsetti, Dasgupta, Morris, and Shin (2004). In that paper, however, complementarity across strategies is exogenous, whereas in ours it arises endogenously.

Our model of engagement takes ownership stakes in the target firm as given. In the second component of our analysis, we develop a simple trading model that builds on our engagement model to characterize target share purchases by the lead activist and small institutions. Market observers highlight the dynamic nature of wolf pack formation, referring to a degree of unusual turnover around the declaration of a campaign by an activist hedge fund. For example, Nathan (2009) writes:

> The market's knowledge of the formation of a wolf pack (either through word of mouth or public announcement of a destabilization campaign by the lead wolf pack member) often leads to additional activist funds entering the fray against the target corporation, resulting in a rapid (and often outcome determinative) change in composition of the target's shareholder base seemingly overnight.

A recent consulting study by Gaurav and Ji (2015) shows that a substantial number of firms subject to 13D filings have more than 10% abnormal turnover between the day the filer crosses the 5% threshold and the day the 13D is filed, suggesting there could be some pre-filing information leakage that prompts wolf pack trading.[2]

Our model generates endogenous turnover in target firm shares because we show that the initial owners of a target firm—before the market becomes aware that the target is amenable to activism—must be institutions who know themselves to be unskilled. Since (as described above) unskilled institutions are never willing to engage management in equilibrium, these initial owners cannot earn reputational rewards. There are thus gains from trade (even in the absence of any market frictions) between these initial owners and potential entrants in the form of institutions who are unsure of

[2] An interesting related issue concerns whether and when a lead activist might want to notify potential wolf pack members of their intentions. In our model this is not a significant issue given that we assume transparent markets. See Kovbasyuk and Pagano (2014) for a theoretical analysis of the optimal strategy for publicizing arbitrage opportunities.

whether they are skilled, because the latter assign positive probability to the prospect of earning reputational rewards.

In our model, the acquisition of a position by the lead activist (in effect, a 13D filing) precipitates the immediate entry of a significant additional number of small institutions. While these institutions know about the potential for activism at the firm before the lead activist buys in, other attractive uses of funds keep them from committing capital to the firm before they are sure that a lead activist will emerge. Others with lower opportunity costs may be willing to buy in earlier, as the real (but smaller) chance of successful engagement in the absence of a lead activist provides sufficient potential returns. Thus, our model predicts that late entrants to activism will be those who have relatively higher opportunity costs of tying up capital. One potential way to interpret this is that more concentrated, smaller, and more "specialized" vehicles (such as other activist or event-driven funds) may be more inclined to acquire a stake only after the filing of a 13D by a lead activist. This is in keeping with Nathan's description above.

Modeling activism as a coordination game also sheds light on the importance of the wolf pack of small institutions whose actions ultimately support the lead activist. In particular, our analysis of the earlier stake acquisition process reveals an important effect of the availability of wolf pack members on the lead activist's willingness to buy a stake. In particular, the larger is the wolf pack the activist can expect to exist at the time of the campaign, the more likely it is that buying a stake will be profitable given the activist's opportunity cost of tying up capital.

Our model also makes relevant predictions about price dynamics in the course of wolf pack formation. First, we predict—in line with several papers in the empirical literature—that the filing of a 13D by a lead activist leads to a jump in the target price. The reason is that the presence of the large activist has a catalytic effect on activism: She not only adds to the activist base, but also energizes the rest of the institutional owners, leading to a discrete jump in the probability of successful engagement. Second, we predict that the returns experienced by target shareholders in the period following a 13D filing will be increasing in the size of the realized wolf pack. This prediction separates our story from purely informational stories in which some investors pile in by herding behind the lead activist: In such stories followers play no intrinsic role in value enhancement and thus generate no price impact, whereas our wolf pack members are key to the value enhancement process and thus move prices as they enter.

Two other aspects of our model are noteworthy. First, we model wolf packs as the team effort of one large and many small institutions. This modeling strategy is motivated by both anecdotal and empirical evidence. For example, in the Brav, Jiang, and Kim (2010) data, between 1994 and 2011 there were over 2,500 activism events involving hedge funds. Of these, fewer than 10% involved two or more funds with stakes large enough to warrant a 13D filing. Even within this 10%, the median length of time across filings was over 150 days, which is far longer than the short-horizon wolf pack formation discussed by commentators such as Briggs and Nathan (and supported by Gaurav and Ji (2015)). Second, the nature of our mechanism interacts with a relevant legal issue. U.S. disclosure rules (Regulation 13D) require investors to file together as a group when their activities are formally coordinated. While explicit coordination is not infeasible, it is costly.[3] It is interesting to note that it is alleged that a significant amount of wolf pack activity is formally uncoordinated, precisely to avoid the costs of joint filing. For example, Briggs (2006) quotes one target manager as saying that "This form of parallel action, driven by numerous independent decisions by like-minded investors, as opposed to explicit cooperation agreements among participants, has allowed hedge funds to avoid being treated as a 'group' for purposes of Regulation 13D." Given this backdrop, the fact that our mechanism requires no explicit coordination

[3]Some of the benefits of avoiding formal coordination include, for example, the ability (by some members of the group) to earn trading profits as well as the avoidance of Poison Pills that may be adopted by the target if it became aware of the group formation at an early stage (Coffee and Palia 2015).

mechanism in the form of communication amongst shareholders adds credence to this view, and thus provides foundations for formally uncoordinated wolf pack activity.

Our analysis is related to the past theoretical literature on the influence of blockholders in corporate governance. Papers in this literature tend to focus either on blockholders who, like here, exercise "voice" by directly intervening in the firm's activities (Shleifer and Vishny, 1986; Kyle and Vila, 1991; Burkart, Gromb, and Panunzi, 1997, Bolton and von Thadden, 1998; Maug, 1998; Kahn and Winton, 1998; Faure-Grimaud and Gromb, 2004), or those who use informed trading, also called "exit," to improve stock price efficiency and encourage correct actions by managers (Admati and Pfleiderer, 2009; Edmans, 2009). Dasgupta and Piacentino (2015) show that the ability to use exit as a governance mechanism is hindered when the blockholder is a flow-motivated fund manager. Flow motivations, modeled via reputation concerns, also a play a key role in our paper. In contrast to Dasgupta and Piacentino (2015), in our paper reputational concerns play a positive role in creating a basis for group activism. Piacentino (2013) also demonstrates a positive role of reputational concerns in corporate finance in the context of feedback effects of prices on investment decisions. Some other papers suggest that blockholders improve decisions by directly providing information to decision makers (see Cohn and Rajan, 2012; Edmans, 2011). Our paper is distinct from all of these in its focus on implicit coordination between different block investors in their value creating activity.[4]

Several existing papers discuss the implications of having multiple blockholders, but from very different perspectives. Zwiebel (1995) models the sharing of private control benefits as part of a coalitional bargaining game, and derives the equilibrium number and size of blockholders who try to optimally capture these benefits. Noe (2002) studies a model in which strategic traders may choose to monitor management, which

[4] Doidge, Dyck, Mahmudi, and Virani (2015) document explicit coordination among institutional investors in Canadian firms through an organization named the Canadian Coalition for Good Governance, and show that such coordinated action can have significant effects.

improves value. In the model, monitoring activities by different investors are perfect substitutes (i.e., if any one investor monitors, the full improvement in value is achieved), and the strategic investors play mixed strategies, where they generally mix between monitoring and buying vs not monitoring and selling. Instead of studying coordination among these monitors, therefore, the paper's focus is on showing that there can be multiple monitors despite the substitutability because of the financial market trading opportunities. Attari, Banerjee, and Noe (2006) show that institutional investors may strategically "dump" shares to induce activists to buy and then intervene directly in the firm's management. There the different blockholders play very distinct roles, as only the activist's direct intervention matters for the governance outcome. Edmans and Manso (2011) model a group of equal-size block holders and ask whether their impact on corporate governance through both exit and voice is larger or smaller than if the same block were held by a single entity. Their main result is that while having a disaggregated stake makes voice less productive due to free rider problems, it helps make the exit channel more effective since the blockholders trade more aggressively when competing for trading profits. We take a very different perspective, asking how the activities of blockholders of different size affect their ability to implicitly coordinate around a target, and how it affects their initial decision to buy a block.

2 The Model

Consider a publicly traded firm which could become a target for shareholder activists, i.e., the firm may potentially become "amenable" to activism in that value could be created by inducing a change in management's policies. Such a change can be induced only if activist investors own shares and successfully engage with management.

The firm has a continuum of shares outstanding of measure 1, of which a measure $\bar{A} \in (0, 1)$ represents the "free float". The remaining shares can be thought to be owned by insiders, say management or founders, who are committed to the current operating strategy. Ex ante, the market believes that the current strategy is optimal and there is no opportunity for improvement, so that firm value is P_ℓ with no scope for profitable activism. At the beginning of the model (at time $t = 0$) there may be a sudden increase in uncertainty about the true potential value of the firm because the market may discover that there is a chance the current strategy is suboptimal. We model this increase in uncertainty as the arrival of a noisy public signal which indicates that the firm is potentially amenable to activism. If such a signal does not arrive, then the firm value remains P_ℓ and there is no scope for profitable activism. If, instead, the public signal arrives, then the firm is characterized by a stochastic fundamental η which measures the amenability of the firm to activism. Activism takes the form of engaging management to modify corporate strategy, and will succeed if and only if a sufficient number of shareholders engage, given η. In particular, we assume that engagement succeeds if the measure of shares that engage, e, is no smaller than η: If $e \geq \eta$, the firm's value will rise to $P_h > P_\ell$. Since $e \in \left[0, \bar{A}\right]$, conditional on the arrival of the public signal, the firm is potentially amenable to activism if and only if $\eta \leq \bar{A}$.

To emphasize the difference between the ex ante certainty of the (stable) firm without the possibility of value enhancement and the uncertainty introduced by the possibility of value enhancing activism, we model the public signal as being highly noisy (in terms of the conditional variance of firm value) by assuming that $\eta \sim N\left(\bar{A}, \sigma_\eta^2\right)$, which implies that conditional on the arrival of the signal, there is a 50% chance that the firm is actually amenable to activism. We denote by $\alpha_\eta = \frac{1}{\sigma_\eta^2}$ the precision of η.

There are two types of investors in the model: a large pool of institutional investors who can each devote only relatively little capital to the firm, and a large activist institution, L, who is able to devote comparatively larger amounts of capital to the firm.

The large activist, L, is available for activism with probability p_L, in which case she enters the model at a date that we label $t = 1$ and considers whether to acquire a stake in the firm. L faces a capital constraint $A_L << \bar{A}$. Conditional on being available for activism, L has an opportunity cost of capital k_L. If L is not available for activism, nothing happens at $t = 1$. The events at $t = 1$ are publicly observed (e.g., through a 13D filing).

Institutional investors all have the potential to be small activists, and exist ex ante in two pools: a large pool of unskilled institutions (who know they are unskilled), and a pool of measure 1 of *potentially* skilled institutions. More concretely, all institutional investors are one of two types: $\theta \in \{G, B\}$. Type G (good) can see signals about firm fundamentals η and have profitable outside investment opportunities Δk_i where $k_i \in [0, \overline{k}]$ is uniformly distributed across the population of type G institutions (and each potentially skilled institution knows their potential k_i), and $\Delta \in \{1 - \delta, 1 + \delta\}$ represents an aggregate shock to outside investment opportunities, where $\delta \in [0, 1)$. The realization of Δ, which equals $(1 + \delta)$ with probability p_Δ, is publicly revealed at $t = 2$. Type B (bad) institutions cannot see signals about fundamentals, and have no profitable outside investment opportunities. The large pool of unskilled institutions know that they are type B ex ante. The pool of potentially skilled institutions do not know their type, but are known to have probability γ of being type G.[5] Potentially skilled institutions can learn their type if they buy shares in the firm and see whether they receive information about firm fundamentals.

Institutional investors are aware that there is a date $t = 1$ when L may enter and seek to establish a position in the firm. They may, in turn, trade shares in the firm, either before they know whether L will be available for activism but after observing that the firm is amenable to activism, i.e. at $t = 0$, or after they know whether L is available for activism and whether she has established a position in the firm, i.e., at some date $t = 2$. Each institution may only acquire shares once, but those institutions who do not acquire shares at $t = 0$ have the option of acquiring shares at $t = 2$.

[5]For parsimony we do not consider investors who already know they are type G. Including a mass of such agents would not affect the model's qualitative results.

Since potentially skilled institutions and the large activist have profitable outside investment opportunities in expectation, they do not own shares in the firm ex ante and will consider buying shares only if the firm is amenable to activism. Thus, unskilled institutions own the $\bar{A}$ shares ex ante. They can choose to sell or hold their shares at any date. Thus, the maximum measure of potential activists who may hold shares in this firm is $\bar{A} < 1$.

At some later date $t = 3$, each outside owner of shares, whether small or large, has the option of engaging ($a_s = E$ or $a_L = E$) or not engaging ($a_s = N$ or $a_L = N$) firm management in order to induce value enhancing changes in the firm. Not engaging is a costless action for both large and small owners.

Institutional investors can potentially enjoy private benefits from acquiring a reputation for being type G. If they own a stake at time $t = 3$ then their own investors will update their beliefs about the institution's type after they observe the outcome of the activism game and the institution's individual action (engage or not). If the prior is updated sufficiently positively ($\hat{\gamma} \geq B$ for some $B \in (\gamma, 1)$), the institution gets private benefit R from participating in the game. Otherwise, the institution gets zero private benefits from participating in the game. The reputational benefit R could arise, for example, from fees on additional funds invested in the institution by existing investors. See Dasgupta and Prat (2008) for a micro-foundation of such a benefit. Choosing to engage the target costs c_s. This may represent the effort of formulating and articulating arguments for changes in target strategy, or—in the case of a campaign led by a large activist—the effort of conducting research to support the effort of the lead activist and of credibly communicating support for the campaign to target management. In addition to these private benefits, the institution receives a payoff of P_h if engagement is successful, capturing a free rider benefit if they did not themselves engage, and a payoff of P_ℓ otherwise. We assume that $R \in (c_s, 2c_s)$, that is, the potential reputational rents are commensurate to the effort required for activism, and $R - c_s \leq (1 - \delta)\gamma\bar{k}$, that is, there exist some institutions for whom the returns to activism are dominated by their opportunity costs.

If the large activist does not engage she receives a payoff of $A_L P_h$ if any engagement by others is successful, and a payoff of $A_L P_\ell$ otherwise. Engagement entails a private effort cost of c_L. This may represent effort spent on pressuring management via discussion, visible publicity campaigns, and proxy proposal formulation and sponsorship. If the large activist engages she receives a payoff of $\beta_L + A_L P_h - c_L$ if the engagement is successful, where $\beta_L > c_L$ represents the excludable benefits earned from successful engagement. For example, if an activist campaign succeeds in appointing new board members, these board members are more likely to be friendly to the lead activist who installed them. In many cases, activist hedge funds managers appoint themselves to corporate boards as part of a successful campaign. This can then also endow them with soft information that leads to valuable trading strategies or other private benefits.[6] If the campaign fails, the payoff to the large activist who engages is $A_L P_\ell - c_L$.

If η is common knowledge, then for each $\eta \in \left(\mathbf{1}_L A_L, \bar{A}\right)$, where $\mathbf{1}_L$ is an indicator function equalling one if the lead activist has bought a stake and zero otherwise, there exist multiple pareto ranked equilibria with full engagement or no engagement. If $\eta < 0$ it is dominant to engage. If $\eta > \bar{A}$ it is dominant not to engage.

To avoid the issue of multiple equilibria, we assume type G institutions who have acquired a position in the firm observe η with small amounts of idiosyncratic noise at the beginning of $t = 3$. The noise in observing entrenchment can be thought to be the

[6]While β_L can also be interpreted, similar to the above, as reputational benefits that accrue to a large activist hedge fund manager from leading a successful activist campaign, we do not explicitly model a reputation mechanism for the large activist since there are likely many sources of private benefits for a successful lead activist.

Our model requires no restriction on the relative values of β_L and R and of c_L and c_s. However, we believe that a natural interpretation is that β_L and c_L are larger than R and c_s respectively. This is because leading an activist campaign is likely to be both more costly and more rewarding than simply participating in one.

result of (potentially imperfect) due diligence (research) carried out by each institution into the target firm. Each institution i receives a private signal $x_{s,i} = \eta + \sigma_s \epsilon_i$ where ϵ_i is standard normal, independent of η and iid across institutions. Denote $\alpha_s = 1/\sigma_s^2$, the precision of each type G institution's signal. The large activist observes η perfectly at $t = 3$.

We now solve the game by backward induction. We first take as given the ownership structure of the firm, and solve for the activism game at $t = 3$. Subsequently, we solve for the endogenous stake purchase and sale decisions of each type of owner.

3 Activism

In this section we analyze the engagement game. We focus throughout on the interesting case in which the target firm is potentially amenable to activism (i.e., a public signal arrived at $t = 0$). For technical reasons, we assume that a small measure λ of the bad types who were ex ante potentially skilled non-strategically randomise in the coordination game, engaging with probability 1/2. In the sequel to Proposition 1 we let $\lambda \to 0$.

Let A_s denote the measure of potentially skilled activists who purchased shares at $t = 0$ or $t = 2$. Apart from the large activist, if present, there are then four groups of owners of the firm at $t = 3$: (i) Skilled institutions ($\theta = G$) in measure $A_s\gamma$, (ii) unskilled ($\theta = B$) strategic institutions in measure $A_s (1 - \gamma) (1 - \lambda)$, (iii) unskilled randomizing institutions in measure $A_s (1 - \gamma) \lambda$, and (iv) initial unskilled institutions that have not yet had an opportunity to sell, in measure $\bar{A} - A_s$. Since agents in groups (ii) and (iv) are identical (none of them receive signals), we refer to them jointly as "unskilled institutions". Skilled institutions receive signals. We look for equilibria in monotone strategies — each skilled institution i engages if and only if his private signal $x_{s,i}$ is weakly below some threshold — and allow for arbitrary symmetric strategies for unskilled institution.

Proposition 1. *For* $\lambda < \min\left[\frac{2\gamma(1-B)}{(1-\gamma)B}, \frac{2(B-\gamma)}{(1-\gamma)B}\right]$, *there exists a* $\underline{\alpha}(\lambda) \in \mathbb{R}_+$ *such that for all* $\alpha_s \geq \underline{\alpha}(\lambda)$ *in equilibrium:*

(i) unskilled small institutions never engage

(ii) skilled small institutions engage iff their signal is below a unique threshold x_s^**,*

(iii) engagement succeeds iff the target fundamental is below a unique threshold η_s^* *and*

(iv) the large activist, if present, engages if and only if $\eta \leq \eta_s^*$*.*

In the limit as $\alpha_s \to \infty$*, the thresholds are given by:*

$$x_s^* = \eta_s^* = \mathbf{1}_L A_L + \gamma A_s \left(1 - \frac{c_s}{R}\right) + \frac{1}{2} A_s (1 - \gamma) \lambda.$$

The proof is in the appendix. Here, we provide some intuition for the result in the case where $\alpha_s \to \infty$. We first note that whenever skilled institutions employ monotone strategies with threshold x_s^*, there exists a critical threshold level of η, which we label η_s^*, such that engagement succeeds if and only if $\eta \leq \eta_s^*$. Further, it is easy to check that as $\alpha_s \to \infty$, $x_s \to \eta$ and $x_s^* \to \eta_s^*$. In other words, in threshold equilibria, skilled institutions always make correct choices in the limit as noise vanishes. This means that unskilled institutions can never earn reputational rents by engaging when engagement fails or not engaging when it succeeds.

Now consider the possibility that unskilled institutions always engage in equilibrium. Then, when engagement succeeds, the only non-engaging owners are the randomising unskilled institutions. When λ is small enough, almost all institutions, whether skilled or unskilled, choose to engage. Thus, the posterior update to reputation from engaging in the case engagement succeeds is arbitrarily small, and not enough to generate reputational rents R. Yet, since skilled institutions never engage when engagement fails as $\alpha_s \to \infty$, there are also no reputational rents arising from engagement in case of failure. In effect, there are no reputational rents to be earned from engaging. Given that security benefits are non-exlusive, and do not require engagement, this implies that no unskilled institution would wish to pay the positive cost of engaging. Thus, it cannot be an equilibrium for unskilled institutions to always engage in equilibrium.

Next, consider the possibility that unskilled institutions never engage in equilibrium. Then, by a similar argument to the previous case, there are no reputational rents to non-engagement as $\alpha_s \to \infty$ and for small enough λ. Engaging however, does deliver reputational rewards in case of success, because all skilled institutions engage in this case if $\alpha_s \to \infty$, whereas for small λ, essentially no unskilled institution does. Thus, unskilled institutions would wish to deviate and engage as long as the expected reputational benefit from engagement exceeds its cost. Viewed from the perspective of uninformed unskilled institutions, the expected benefit is never larger than $\Pr\left(\eta \le \bar{A}\right) R = R/2$ whereas the cost is c_s. Thus, since $R < 2c_s$, the deviation is unattractive, and thus unskilled institutions can never engage in equilibrium. The key intuition is that for those institutions who decided to gamble on establishing a reputation for being skilled (i.e., those whose expected opportunity costs were not too high), but subsequently discovered themselves to be unskilled, the best bet is to sit tight and not expend any resources on trying to "pretend" to be skilled. An important economic implication of this is that reputational rents can be achieved only by participating in a successful activism campaign. There are never rents for remaining inactive, even when activism fails. The proof in the appendix also shows that no mixed equilibria can arise.

We now turn to the skilled institutions. As a first step, we consider the case where the large activist is absent, or—equivalently—where $A_L = 0$. It is important to recognize that the payoffs of any given skilled institution are determined jointly by the exogenous fundamental, η, and the endogenous measure of other skilled institutions who engage, which we label e_s. In other words, both uncertainty about firm fundamentals and uncertainty about the actions of other skilled institutions, i.e., *strategic uncertainty*, is relevant to each institution. When η is common knowledge, it is clear that there is neither uncertainty about firm fundamentals nor strategic uncertainty. In the $\alpha_s \to \infty$ limit, uncertainty about firm fundamentals vanishes. However, interestingly, strategic uncertainty does *not* vanish. As $\alpha_s \to \infty$, each skilled institution remains highly uncertain about his *relative* ranking in the population of skilled institutions. In particular, each skilled institution has *uniform* beliefs over the *proportion* of skilled institutions who have received signals about η which are lower than his own. A discussion of the theoretical foundation for this result can be found in Morris and Shin (2002).

Using this characterization of strategic uncertainty delivers a heuristic method for computing the threshold η_s^*, as follows. The skilled institution with signal x_s^* must be indifferent between engaging and not engaging. Further, all skilled institutions with signals lower than his will wish to engage. Thus, the proportion of skilled institutions with signals lower than his is simply e_s. In the limit as $\alpha_s \to \infty$, the skilled institution with signal x_s^* believes that $e_s \sim U(0,1)$. Then, since unskilled institutions do not engage, if the large activist is absent, and when $\lambda \to 0$, so that there are now no randomising unskilled institutions, this skilled institution's evaluation of the probability of successful engagement is simply $\Pr(\gamma A_s e_s \geq \eta_s^*)$. Since $e_s \sim U(0,1)$ this can be rewritten as $1 - \frac{\eta_s^*}{\gamma A_s}$, giving rise to the indifference condition:

$$R\left(1 - \frac{\eta_s^*}{\gamma A_s}\right) = c_s,$$

which immediately implies that $\eta_s^* = \gamma A_s \left(1 - \frac{c_s}{R}\right)$, which is exactly the value of η_s^* in Proposition 1 for $\mathbf{1}_L = \lambda = 0$.

Finally, we turn to the large activist. While the strategy of the large activist is trivial, since she knows η, the effect of her presence on smaller skilled institutions is not. Does the presence of a large activist have a tangible effect on the probability of successful engagement over and above the impact arising from the presence of dispersed skilled institutions? In order to isolate the potential effect cleanly we must control for total holdings by those owners who may engage—the large activist and the potentially skilled institutions—which we refer to as the "activist base". In other words, we must consider the change in the efficacy of activism when, for a given activist base, we replace the large activist by an equal measure of dispersed potentially skilled institutions.

In our dynamic model, the share acquisition decisions of small institutions at $t = 0$ anticipate the potential arrival of the large activist which—if it occurs—may potentially spur further share acquisitions by other dispersed institutions. Thus, fixing an initial set of parameters, it is never the case in equilibrium that the total size of the activist base is identical with and without the presence of the large activist. Nevertheless, our model provides the basis for carrying out a comparative statics exercise which pinpoints the impact of the large activist: We compare the efficacy of activism under two potential ownership structures. Under the first ownership structure there are only small institutions in a total measure A^T (i.e., $A_s = A^T$). Under the second ownership structure a measure A_L of the small institutions are replaced by the single large activist L, so that $A_s + A_L = A^T$. For simplicity, let $\lambda \to 0$. By using Proposition 1, we can compare the fundamental levels below which activism succeeds under the two ownership structures:

Corollary 1. *There exists a range of fundamentals of measure $A_L \left[1 - \gamma \left(1 - \frac{c_s}{R}\right)\right]$ for which engagement is successful in a target firm if and only if a large activist is present.*

The result follows from comparing η_s^* (for $A_s = A^T$) and η_L^* (for $A_s = A^T - A_L$):

$$\eta_L^* - \eta_s^* = A_L + \gamma \left(A^T - A_L\right) \left(1 - \frac{c_s}{R}\right) - \gamma A^T \left(1 - \frac{c_s}{R}\right) = A_L \left[1 - \gamma \left(1 - \frac{c_s}{R}\right)\right] > 0.$$

In words, fixing the size of the activist base, if a measure of dispersed potentially skilled institutions is replaced by a single large activist, activism becomes more effective. To appreciate the forces behind this result, let us compare the engagement threshold of the skilled institutions. Under the ownership structure with only small institutions, this engagement threshold is $\gamma A^T \left(1 - \frac{c_s}{R}\right)$, i.e., skilled institutions engage only when they (correctly) believe $\eta < \gamma A^T \left(1 - \frac{c_s}{R}\right)$. Under the alternative ownership structure where a measure A_L of potentially skilled institutions are replaced by a single large activist, the engagement threshold *rises* to $A_L + \gamma \left(A^T - A_L\right) \left(1 - \frac{c_s}{R}\right)$. In other words, the presence of a well-informed large activist in their midst makes skilled institutions more aggressive in their engagement strategy: The presence of a large activist has a coordinating effect on smaller skilled institutions.[7]

4 Trading Dynamics

We now turn to trading dynamics prior to the activism game. Throughout we focus on the limiting equilibrium from above where $\alpha_s \to \infty$ and $\lambda \to 0$. We model trading at all dates as a reduced form transparent market, where all participants share common information about the game and identity of all traders, and thus shares change hands at their expected non-excludable value. For example, this could be modeled as a Kyle (1985) type market with a risk neutral market maker and no noise trade. We note first that since the lead activist and potentially skilled institutions have profitable outside opportunities in expectation, they have no reason to own or purchase shares in the firm if it is not known that it is potentially amenable to activism, and thus the free float of $\bar{A}$ will be initially owned by unskilled institutions.[8] Next, given the results in Proposition 1, unskilled institutions know that they will never choose to engage the target, and can thus realize only the non-excludable value of the shares. As a result, they will be indifferent between holding and selling their shares at every point in the game. Given this, we assume throughout that any potential purchaser can always buy shares at the transparent market price as long as the free float has not been completely

[7] Here we have assumed that part of the pool of *potentially* skilled institutions is replaced by the large activist. Qualitatively similar results are obtained if we assume part of the pool of *ex post* skilled institutions is replaced by the large activist.

[8] Note that we have assumed no players have private information with respect to whether the firm will become amenable to activism, so there is no reason to buy shares earlier in order to "speculate" on this possibility.

exhausted.[9]

4.1 Following the Lead Activist

We proceed backward, beginning with potential trading among institutional investors at $t = 2$, after it is known whether the large activist has entered or not. In particular, potentially skilled institutions who did not acquire a position in the firm at $t = 0$ have the option of doing so at $t = 2$. The strategy of these institutions at $t = 2$ are conditioned on the actions of the large activist, who chooses at $t = 1$, and on their expected private opportunity cost of capital, $\Delta\gamma k_i$. Since the incentive to acquire is decreasing in $\Delta\gamma k_i$, we focus on strategies in which small institutions acquire if and only if their realized opportunity cost $\Delta\gamma k_i$ is below some threshold value, i.e., monotone strategies (as in the activism game). Accordingly, we characterize two thresholds: $K_2^*(A_L, \Delta)$ and $K_2^*(0, \Delta)$, representing the cases where the large activist holds a position in the firm and where she does not, respectively, and the thresholds clearly depend on the realization of Δ.

What about the potentially skilled institutions who acquired shares at $t = 0$, before knowing whether L would enter or not, and before knowing the realization of Δ? As will become clear later, an institution will buy shares at $t = 0$ only if his worst case opportunity cost, $(1 + \delta)\gamma k_i$, is below the minimum $t = 2$ purchase threshold. Thus, using the same reasoning as above, denote the threshold for purchase at $t = 0$ by K_0^*. We guess (and later verify) that $K_0^* \leq \min\{K_2^*(A_L, \Delta), K_2^*(0, \Delta)\}$, i.e., it is only institutions with strictly lower worst case opportunity costs who will choose to acquire positions before they know Δ and whether L enters or not. Further, we assume that if any institution is indifferent between entry at $t = 0$ and $t = 2$, they enter at $t = 0$.

[9] In the Kyle (1985) type market mentioned above, this would be equivalent to assuming that all unskilled institutions who own the stock at any stage place an "optional" market order to sell their shares with the market maker, where the market maker is free to complete the order or not at the market price depending on demand for the shares.

For example, this could be because there are small trading profits available if these institutions trade prior to the 13D announcement because they are better able than unskilled institutions to predict the availability of the lead activist. For parsimony, we do not model this asymmetric information trading game, but we believe it would not significantly alter the model's qualitative results.

By definition, institutions who acquire a position in the firm at any date t purchase their shares from unskilled institutions. Since the unskilled institutions are rational, share the same information at the point of acquisition (recall that the skilled institutions' private signals are only received at the beginning of $t = 3$), and are only willing to trade at fair value, the sole source of gains for potentially skilled institutions arises from their net private reputational rents $(R - c_s)$ from successful activism. In other words, any potentially skilled institutions who choose to purchase shares and participate in the activism game do so solely to determine and advertise their type in an attempt to gain reputation. In turn, since the activism game at $t = 3$ is played with vanishing noise, institutions who turn out to be skilled engage only when engagement is successful. Thus, a potentially skilled institution can expect to receive $R - c_s$ in the event that they turn out to be skilled and engagement is successful, and nothing other than the fair non-excludable value of their shares otherwise. Engagement succeeds whenever the level of entrenchment is below the relevant threshold, which in turn depends on the size of the activist base.

In case L is present, under our maintained hypothesis that $K_0^* \leq \min\{K_2^*(A_L, \Delta), K_2^*(0, \Delta)\}$, the mass of activists (the large activist plus potentially skilled institutions) is given by $A_L + \frac{K_2^*(A_L,\Delta)}{\Delta\gamma\bar{k}}$,where $A_s = \frac{K_2^*(A_L,\Delta)}{\Delta\gamma\bar{k}} = \Pr(\Delta\gamma k_i \leq K_2^*(A_L, \Delta))$. Given this mass of activists, Proposition 1 implies that the entrenchment threshold in the activism game is $A_L + \gamma\frac{K_2^*(A_L,\Delta)}{\Delta\gamma\bar{k}}\left(1 - \frac{c_s}{R}\right)$, so that the expected payoff from share acquisition for any given potentially skilled institution is:

$$\Pr\left(\eta \leq A_L + \gamma\frac{K_2^*(A_L, \Delta)}{\Delta\gamma\bar{k}}\left(1 - \frac{c_s}{R}\right)\right)(R - c_s)$$

while his opportunity cost is $\Delta\gamma k_s^i$. For consistency with the monotone strategy with threshold $K_2^*(A_L,\Delta)$, the potentially skilled institution with opportunity cost $K_2^*(A_L,\Delta)$ must be exactly indifferent, i.e., $K_2^*(A_L,\Delta)$ is implicitly determined by

$$\Pr\left(\eta \leq A_L + \gamma\frac{K_2^*(A_L,\Delta)}{\Delta\gamma\bar{k}}\left(1-\frac{c_s}{R}\right)\right)(R-c_s) = K_2^*(A_L,\Delta). \tag{1}$$

It is easy to see that as long as there is sufficient volatility in entrenchment levels, there exists a unique such threshold $K_2^*(A_L,\Delta)$:

Lemma 1. *There exists a $\underline{\sigma}_\eta \in \mathbb{R}_+$ such that if $\sigma_\eta \geq \underline{\sigma}_\eta$ there is a unique solution to (1).*

The proof is in the appendix. The intuition for uniqueness is as follows: Both sides of the equation implicitly defining $K_2^*(A_L,\Delta)$ are increasing in $K_2^*(A_L,\Delta)$. Under these circumstances, a sufficient condition for uniqueness is that rates of change with respect to $K_2^*(A_L,\Delta)$ are strictly ranked. The left hand side is a scaled probability in η. As long as the density function of η is sufficiently spread out, the left hand side will always increase slower than the right hand side (the 45 degree line), giving rise to uniqueness. The economic interpretation of this condition is that sufficient variation in potential entrenchment levels prevents small changes in the mass of activists from having too much influence on success probabilities.

In case L is absent, as long as $K_0^* \leq \min\{K_2^*(A_L,\Delta), K_2^*(0,\Delta)\}$, the mass of activists is given by $\frac{K_2^*(0,\Delta)}{\Delta\gamma\bar{k}}$. Given this mass of activists, Proposition 1 implies that the entrenchment threshold in the activism game is $\gamma\frac{K_2^*(0,\Delta)}{\Delta\gamma\bar{k}}\left(1-\frac{c_s}{R}\right)$, so that $K_2^*(0,\Delta)$ is implicitly defined by:

$$\Pr\left(\eta \leq \gamma\frac{K_2^*(0,\Delta)}{\Delta\gamma\bar{k}}\left(1-\frac{c_s}{R}\right)\right)(R-c_s) = K_2^*(0,\Delta). \tag{2}$$

The sufficient condition for the uniqueness of $K_2^*(0,\Delta)$ is identical to that for $K_2^*(A_L,\Delta)$. Thus, we state without proof:

Lemma 2. *If $\sigma_\eta \geq \underline{\sigma}_\eta$ there is a unique solution to (2).*

Given Lemmas 1 and 2, we can now compare the thresholds $K_2^*(A_L, \Delta)$ and $K_2^*(0, \Delta)$ to determine the effect of the entry of the large activist on subsequent entry by potentially skilled institutions. We show:

Proposition 2. *$K_2^*(A_L, \Delta) > K_2^*(0, \Delta)$ for all Δ.*

The proof is in the appendix. The intuition for this result can be understood as follows. The reason potentially skilled institutions may acquire shares in the firm even though they trade with rational traders who charge the full expected continuation value is due to their expected future net reputational benefits from successful coordinated engagement. Such benefits must be offset against their opportunity costs, $\Delta\gamma k_s^i$, giving rise to a threshold level of opportunity costs below which share acquisition occurs and above which it does not. Anything that increases expected reputational benefits, increases incentives to acquire blocks and moves the opportunity cost threshold upwards.

Consider the potentially skilled institution with opportunity cost $K_2^*(0, \Delta)$. This institution is exactly indifferent between acquiring a share and not acquiring a share if the large activist does *not* participate, in which case—by monotonicity—exactly $\frac{K_2^*(0,\Delta)}{\Delta\gamma\bar{k}}$ institutions will participate, giving rise to a expected net benefit from share acquisition of

$$\Pr\left(\eta \leq \gamma \frac{K_2^*(0, \Delta)}{\Delta\gamma\bar{k}}\left(1 - \frac{c_s}{R}\right)\right)(R - c_s).$$

However, imagine now that the large activist *does* participate. *Even if skilled institutions did not change their behavior*, the probability of successful engagement would rise to $\Pr\left(\eta \leq A_L + \gamma\frac{K_2^*(0,\Delta)}{\Delta\gamma\bar{k}}\left(1 - \frac{c_s}{R}\right)\right)$, and thus the institution with opportunity cost $K_2^*(0, \Delta)$ would no longer be exactly indifferent between acquiring a share or not: He would strictly prefer to acquire shares. By continuity, this means that some institutions with strictly higher opportunity costs would strictly prefer to participate. In other words, the threshold level of opportunity cost would increase.

The implication of this result is that the entry of a large activist spurs additional entry by potentially skilled institutions: A wolf pack forms, given the presence of a leader.

4.2 The Lead Activist

our earlier analysis, we know that if L enters, the size of the activist base will increase to $A_L + \frac{K_2^*(A_L,\Delta)}{\Delta\gamma\overline{k}}$, giving rise to an expected payoff for entry of:

$$(1-p_\Delta)\left[A_L \Pr\left(\eta \leq A_L + \gamma\frac{K_2^*\left(A_L,(1-\delta)\right)}{(1-\delta)\gamma\overline{k}}\left(1-\frac{c_s}{R}\right)\right)(\beta_L - c_L)\right]$$
$$+p_\Delta\left[A_L \Pr\left(\eta \leq A_L + \gamma\frac{K_2^*\left(A_L,(1+\delta)\right)}{(1+\delta)\gamma\overline{k}}\left(1-\frac{c_s}{R}\right)\right)(\beta_L - c_L)\right] \tag{3}$$

which will be compared to L's opportunity cost k_L. We show that

Proposition 3. *For a given $(A_L, k_L, \beta_L, c_L, R, c_s, \gamma)$ the large activist enters only if $\overline{k}$ is small enough.*

The proof is in the appendix. The smaller is $\overline{k}$, the more attractive is entry for potentially skilled institutions. Accordingly, the result shows that the large activist will enter only if the anticipated skilled institutional ownership is large enough.

4.3 Anticipating the Lead Activist

At $t = 0$ institutions have the option of buying into the firm before they know whether L will enter, or to wait until uncertainty over both L's presence and Δ is resolved. Note that since there is a $1-p_L$ probability that L is unavailable for activism, there is always ex ante uncertainty with regard to L's presence. The behavior of potentially skilled institutions is characterized by a threshold: institutions with worst case opportunity costs, $(1+\delta)\gamma k_i$, below K_0^* will enter early (by our tie-breaking assumption) and those with higher opportunity costs will wait until $t = 2$. Note that, since it is costless to wait and verify whether L is present (because the transaction price for share acquisition is always fair and the reputational benefits are received after $t = 3$) and to learn Δ, a potentially skilled institution can only wish to buy a share at $t = 0$ if his k_i is low enough that he would prefer to own regardless of whether L enters or not, and in the worst case cost scenario where $\Delta = (1 + \delta)$. In other words, K_0^* is defined by:

$$\Pr\left(\eta \leq \gamma \frac{K_0^*}{(1+\delta)\gamma \bar{k}} \left(1 - \frac{c_s}{R}\right)\right)(R - c_s) = K_0^*,$$

which has a unique solution if $\sigma_\eta \geq \underline{\sigma}_\eta$. But notice that this condition is identical to (2) when we set $\Delta = (1 + \delta)$, and thus $K_0^* = K_2^*(0, (1 + \delta))$. Now note that that $K_2^*(0, (1 + \delta)) < K_2^*(0, (1 - \delta))$ is immediate, and from Proposition (2) we know that $K_2^*(0, \Delta) < K_2^*(A_L, \Delta)$. Thus, we have $K_0^* \leq \min\{K_2^*(A_L, \Delta), K_2^*(0, \Delta)\}$ as conjectured above.

5 Wolf Pack Formation

In this section, we summarize the empirical implications of our model for the dynamics of wolf pack formation. Our predictions can be classified into implications for ownership dynamics and price dynamics.

5.1 Ownership dynamics

In the unique equilibrium of our model:

1. Some small institutions (those with low worst case opportunity costs) acquire positions in the target firm at $t = 0$ in potential anticipation of the large activist's arrival.

2. If the large activist is available for activism at $t = 1$, she acquires a stake in the firm if and only if she predicts that there will be a sufficiently large activist base

given her opportunity cost of acquiring a stake (i.e., if she believes that the total expected mass of small institutions at $t = 3$ is large enough).

3. Conditional on the large activist's entry at $t = 1$ there will be additional entry by small institutions with higher opportunity costs.

Imagine that the entry of the large activist is synonymous with the filing of a 13D. Then, combining these dynamic implications delivers several empirical implications:

Remark 1. Firms in which 13Ds are filed will have substantially higher activist presence (measure $A_L + \frac{K_2^*(A_L,\Delta)}{\Delta\gamma\bar{k}}$) than firms in which they are not ($\frac{K_2^*(0,\Delta)}{\Delta\gamma\bar{k}}$).

The empirical content of this depends on our definition of an activist. If we define an activist to be an institutional investor, as in the model, then this result captures the Brav et al (2008) finding that firms in which activist hedge funds file 13Ds have high institutional ownership.

Remark 2. There will be significant additional accumulation of activist shares following a 13D filing (a measure $\frac{K_2^*(A_L,\Delta)}{\Delta\gamma\bar{k}}$ - $\frac{K_0^*}{(1+\delta)\gamma\bar{k}}$ of additional small institutions will enter conditional on the large activist's entry).

Thus, one should expect abnormal turnover in target shares following a 13D filing. Further, there may be differences in institutions who buy into a target firm's shares before and after a 13D filing:

Remark 3. Late entrants to wolf packs have higher opportunity costs of locking up capital than early entrants.

5.2 Price dynamics

To examine the dynamics of prices in our model we first set up some additional notation. Let P_t denote the equilibrium price at t. The price P_t is the expected value of the firm at $t = 3$, taking into account the expected probability of success and failure in activism given the information available at t and thus $P_t \in [P_\ell, P_h]$. The price reacts to information in the model as follows:

1. At $t = 1$, uncertainty on whether a large activist will be available is resolved. Conditional on being available, the price rises if the large activist acquires a stake. If the large activist is not available, the price falls. If the large activist is available but does not acquire a stake, the price does not react, because—conditional on availability—the acquisition decision is predictable.

2. At $t = 2$, uncertainty on the aggregate shock to outside investment opportunities of small institutions resolves. The price rises if opportunity costs fall and many small institutions enter. The price falls if opportunity costs rise and few small institutions enter.

3. At $t = 3$, uncertainty on the level of entrenchment, and therefore the outcome of engagement, resolves. The price rises if engagement succeeds and falls otherwise.

As above, if the entry and acquisition of a large activist is synonymous with the filing of a 13D, then we have the following empirical implications.

Remark 4. Targets experience positive returns upon the filing of a 13D (i.e., conditional on the entry of a large activist, $P_1 > P_0$).

This implication has wide support in the empirical literature on hedge fund activism. A significant number of papers find that targets experience positive abnormal short-term returns conditional on the filing of a 13D (see Brav et al 2010 for a survey of this literature).

Remark 5. Target returns following the filing of a 13D are increasing in the size of the wolf pack (i.e., $P_2 - P_1$ is decreasing in Δ).

We are aware of no systematic evidence for this implication, which therefore represents a testable prediction of our model. Further, this implication separates our story from purely information-based stories of institutional share acquisition following a 13D filing: In the latter story, the post-13D entrants add no value to the target and should have no price impact; In our model, the post-13D entrants are key participants in the value enhancement process and thus the price reacts positively to higher levels of entry.

6 Conclusion

The possibility of group action by activists has important implications for both corporate executives who might face activist campaigns and regulators who set disclosure rules and corporate governance policy. In this paper we show that implicit coordination can play a powerful role in activist campaigns, and that this coordination is bolstered by a strong strategic complementarity among activist's strategies that arises naturally from the industrial organization of the money management industry. We also demonstrate that the emergence of a lead activist has an important catalytic effect on the aggressiveness of other activists. Finally, we show that empirically demonstrated trading dynamics are consistent with our model of implicit coordination, and provide further testable hypotheses. Our results should enable future empirical researchers to better study the mechanics and implications of wolf pack tactics. Future work could also examine the role that explicit collusion or intentional information leakage might play in either substituting for or complementing the implicit coordination mechanism we model.

Appendix

Proof of Proposition 1: Denote by $\mathbf{1}_L$ the indicator function that is equal to 1 is the large activist is present. Denote the probability with which each unskilled institution engages by $p_e \in [0,1]$. p_e is formally a function of $\mathbf{1}_L$, but we suppress this dependence here for notational brevity as we shall show below that the strategies of the small unskilled institutions are independent of the presence of the large activist in equilibrium. The strategies of the skilled small institutions will depend on $\mathbf{1}_L$, p_e and λ. Denote the threshold by $x_s^*(\mathbf{1}_L, p_e, \lambda)$. Finally, define $\hat{A} = \bar{A} - \mathbf{1}_L A_L$, the measure of shares that is jointly owned by small institutions, skilled or unskilled. Since $x_{s,j}|\eta \sim N(\eta, \sigma_s^2)$, for each η, the measure of engagement by small institutions is given by

$$A_s \gamma \Pr(x_{s,j} \le x_s^*(\mathbf{1}_L, p_e, \lambda)|\eta) + \left(A_s(1-\gamma)(1-\lambda) + \left(\hat{A} - A_s\right)\right) p_e + A_s(1-\gamma)\frac{\lambda}{2}.$$

The large activist will engage if present if and only if

$$A_L + A_s \gamma \Pr(x_{s,j} \le x_s^*(\mathbf{1}_L, p_e, \lambda)|\eta) + \left(A_s(1-\gamma)(1-\lambda) + \left(\hat{A} - A_s\right)\right) p_e + A_s(1-\gamma)\frac{\lambda}{2} \ge \eta.$$

Thus, engagement is successful if and only if

$$\mathbf{1}_L A_L + A_s \gamma \Phi\left(\sqrt{\alpha_s}\left(x_s^*(\mathbf{1}_L, p_e, \lambda) - \eta\right)\right) + \left(A_s(1-\gamma)(1-\lambda) + \left(\hat{A} - A_s\right)\right) p_e + A_s(1-\gamma)\frac{\lambda}{2} \ge \eta.$$

The LHS is decreasing in η, the RHS is increasing in η, so there exists $\eta_s^*(p_e, \lambda)$ such that engagement is successful if and only if $\eta \le \eta_s^*(p_e, \lambda)$, where $\eta_s^*(p_e, \lambda)$ is defined by

$$\begin{array}{c} \mathbf{1}_L A_L + A_s \gamma \Phi\left(\sqrt{\alpha_s}\left(x_s^*(\mathbf{1}_L, p_e, \lambda) - \eta_s^*(\mathbf{1}_L, p_e, \lambda)\right)\right) + \\ \left(A_s(1-\gamma)(1-\lambda) + \left(\hat{A} - A_s\right)\right) p_e + A_s(1-\gamma)\frac{\lambda}{2} \end{array} = \eta_s^*(\mathbf{1}_L, p_e, \lambda). \tag{4}$$

Which implies that

$$x_s^*(\mathbf{1}_L, p_e, \lambda) = \begin{array}{c} \eta_s^*(\mathbf{1}_L, 0, \lambda) + \\ \frac{1}{\sqrt{\alpha_s}} \Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L, 0, \lambda) - \mathbf{1}_L A_L - \left(A_s(1-\gamma)(1-\lambda) + \left(\hat{A} - A_s\right)\right) p_e - A_s(1-\gamma)\frac{\lambda}{2}}{A_s \gamma}\right) \end{array}.$$

Note that this implies that as $\alpha_s \to \infty$, $x_s^*(\mathbf{1}_L, p_e, \lambda) \to \eta_s^*(\mathbf{1}_L, 0, \lambda)$.

We now compute the posterior reputation of each small institution in equilibrium. Since individual small institutions may engage (E) or not (N), and engagement may succeed ($S := \{\eta \leq \eta_s^* (p_e, \lambda)\}$) or fail ($F := \{\eta > \eta_s^* (p_e, \lambda)\}$), there are four possible posterior reputations: $\hat{\gamma}(S, E), \hat{\gamma}(F, E), \hat{\gamma}(S, N)$, and $\hat{\gamma}(F, N)$.

$$
\begin{aligned}
\hat{\gamma}(S,E) &= \Pr(\theta = G|S,E) \\
&= \frac{\frac{A_s\gamma}{\hat{A}} \Pr(S,E|\theta=G)}{\frac{A_s\gamma}{\hat{A}} \Pr(S,E|\theta=G) + \frac{A_s(1-\gamma)(1-\lambda)}{\hat{A}} \Pr(S)\, p_e + \frac{A_s(1-\gamma)\lambda}{\hat{A}} \frac{1}{2} + \frac{\hat{A}-A_s}{\hat{A}} \Pr(S)\, p_e} \\
&= \frac{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda), S)}{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda), S) + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) \Pr(S)\, p_e + A_s(1-\gamma) \Pr(S) \frac{\lambda}{2}} \\
&= \frac{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda) | S)}{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda) | S) + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) p_e + A_s(1-\gamma) \frac{\lambda}{2}}.
\end{aligned}
$$

By analogy

$$
\begin{aligned}
\hat{\gamma}(F,E) &= \frac{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda) | F)}{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda) | F) + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) p_e + A_s(1-\gamma) \frac{\lambda}{2}}, \\
\hat{\gamma}(S,N) &= \frac{A_s\gamma \Pr(x_s > x_s^*(\mathbf{1}_L, p_e, \lambda) | S)}{A_s\gamma \Pr(x_s > x_s^*(\mathbf{1}_L, p_e, \lambda) | S) + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) (1-p_e) + A_s(1-\gamma) \frac{\lambda}{2}}, \\
\hat{\gamma}(F,N) &= \frac{A_s\gamma \Pr(x_s > x_s^*(\mathbf{1}_L, p_e, \lambda) | F)}{A_s\gamma \Pr(x_s > x_s^*(\mathbf{1}_L, p_e, \lambda) | F) + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) (1-p_e) + A_s(1-\gamma) \frac{\lambda}{2}}.
\end{aligned}
$$

Denoting by I the information set of a given player and by $\mathbf{1}$ the indicator function which is equal to one if its argument is true, the payoffs from engagement are given by:

$$
\Pr(S|I)\left[\mathbf{1}(\hat{\gamma}(S,E) \geq B) R + P_h\right] + (1 - \Pr(S|I))\left[\mathbf{1}(\hat{\gamma}(F,E) \geq B) R + P_l\right] - c_s,
$$

whereas the payoffs from non-engagement are given by:

$$
\Pr(S|I)\left[\mathbf{1}(\hat{\gamma}(S,N) \geq B) R + P_h\right] + (1 - \Pr(S|I))\left[\mathbf{1}(\hat{\gamma}(F,N) \geq B) R + P_l\right].
$$

First consider the unskilled small institutions, so that $I = \varnothing$. We first show that:

Lemma 3. *For* $\lambda < \min\left[\frac{2\gamma(1-B)}{(1-\gamma)B}, \frac{2(B-\gamma)}{(1-\gamma)B}\right]$ *there exists* $\underline{\alpha}_{III}(\lambda) \in \mathbb{R}_+$ *such for all* $\alpha_s \geq \underline{\alpha}_{III}(\lambda)$, *unskilled small institutions must choose* $p_e = 0$ *in equilibrium.*

Proof of Lemma: First we show that for sufficiently precise signals, $p_e = 0$ is a best response by unskilled institutions to a monotone strategy with threshold $x_s^*(0,\lambda)$ used by skilled institutions. For $p_e = 0$ the posteriors are as follows:

$$\hat{\gamma}(S,E) = \frac{\gamma \Pr\left(x_s \leq x_s^*(\mathbf{1}_L, 0, \lambda)|S\right)}{\gamma \Pr\left(x_s \leq x_s^*(\mathbf{1}_L, 0, \lambda)|S\right) + (1-\gamma)\frac{\lambda}{2}} \underset{\alpha_s\to\infty}{\to} \frac{\gamma}{\gamma + (1-\gamma)\frac{\lambda}{2}}.$$

For $\lambda < \frac{2\gamma(1-B)}{(1-\gamma)B}$, $\frac{\gamma}{\gamma+(1-\gamma)\frac{\lambda}{2}} > B$, and thus there exists $\underline{\alpha}_1(\lambda) \in \mathbb{R}_+$ such that for $\alpha_s \geq \underline{\alpha}_1(\lambda)$, $\hat{\gamma}(S,E) \geq B$.

$$\hat{\gamma}(F,E) = \frac{\gamma \Pr\left(x_s \leq x_s^*(\mathbf{1}_L, 0, \lambda)|F\right)}{\gamma \Pr\left(x_s \leq x_s^*(\mathbf{1}_L, 0, \lambda)|F\right) + (1-\gamma)\frac{\lambda}{2}} \underset{\alpha_s\to\infty}{\to} 0.$$

Thus, for any λ, there exists $\underline{\alpha}_2(\lambda) \in \mathbb{R}_+$ such that for $\alpha_s > \underline{\alpha}_2(\lambda)$, $\hat{\gamma}(F,E) < B$.

$$\hat{\gamma}(S,N) = \frac{A_s\gamma \Pr\left(x_s > x_s^*(\mathbf{1}_L, 0, \lambda)|S\right)}{A_s\gamma \Pr\left(x_s > x_s^*(\mathbf{1}_L, 0, \lambda)|S\right) + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) + A_s(1-\gamma)\frac{\lambda}{2}} \underset{\alpha_s\to\infty}{\to} 0.$$

Thus, for any λ, there exists $\underline{\alpha}_3(\lambda) \in \mathbb{R}_+$ such that for $\alpha_s \geq \underline{\alpha}_3(\lambda)$, $\hat{\gamma}(S,N) < B$.

$$\begin{aligned}
\hat{\gamma}(F,N) &= \frac{A_s\gamma \Pr\left(x_s > x_s^*(\mathbf{1}_L, 0, \lambda)|F\right)}{A_s\gamma \Pr\left(x_s > x_s^*(\mathbf{1}_L, 0, \lambda)|F\right) + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) + A_s(1-\gamma)\frac{\lambda}{2}} \\
&\underset{\alpha_s\to\infty}{\to} \frac{A_s\gamma}{A_s\gamma + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right) + A_s(1-\gamma)\frac{\lambda}{2}} \\
&= \frac{\gamma}{\gamma + (1-\gamma)\left(1-\frac{\lambda}{2}\right) + \frac{\hat{A}}{A_s} - 1} \leq \frac{\gamma}{\gamma + (1-\gamma)\left(1-\frac{\lambda}{2}\right)}, \text{ since } \hat{A} \geq A_s.
\end{aligned}$$

For $\lambda < \frac{2(B-\gamma)}{(1-\gamma)B}$, $\frac{\gamma}{\gamma+(1-\gamma)\left(1-\frac{\lambda}{2}\right)} < B$, and thus there exists $\underline{\alpha}_4(\lambda) \in \mathbb{R}_+$ such that for $\alpha_s > \underline{\alpha}_4(\lambda)$, $\hat{\gamma}(F,N) < B$. Now, setting

$$\underline{\alpha}_I(\lambda) := \max\left[\underline{\alpha}_1(\lambda), \underline{\alpha}_2(\lambda), \underline{\alpha}_3(\lambda), \underline{\alpha}_4(\lambda)\right],$$

for $\alpha_s \geq \underline{\alpha}_I(\lambda)$, we can write the payoffs for unskilled small institutions from engaging as follows:

$$\Pr(S)(R + P_h) + (1 - \Pr(S))P_l - c_s,$$

whereas payoffs from not engaging are

$$\Pr(S) P_h + (1 - \Pr(S))P_l.$$

Thus, $p_e = 0$ is optimal whenever

$$\Pr(S) \leq \frac{c_s}{R},$$

which is always satisfied because $\Pr(S) = \Pr(\eta \leq \eta_s^*(0,\lambda)) < \Pr(\eta \leq 1) = \frac{1}{2}$ since $\eta_s^*(0,\lambda) < 1$, whereas $\frac{c_s}{R} \geq \frac{1}{2}$ since $R \leq 2c_s$.

Next we show that $p_e = 1$ cannot arise in equilibrium. For $p_e = 1$ the posteriors are as follows:

$$\begin{aligned}
\hat{\gamma}(S,E) &= \frac{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, 1, \lambda)|S)}{A_s\gamma \Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda)|S) + A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s + A_s(1-\gamma)\frac{\lambda}{2}} \\
&\underset{\alpha_s\to\infty}{\to} \frac{A_s\gamma}{A_s\gamma + A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s + A_s(1-\gamma)\frac{\lambda}{2}} \\
&= \frac{\gamma}{\gamma + (1-\gamma)\left(1-\frac{\lambda}{2}\right) + \frac{\hat{A}}{A_s} - 1} \leq \frac{\gamma}{\gamma + (1-\gamma)\left(1-\frac{\lambda}{2}\right)}.
\end{aligned}$$

This is identical to the case for $p_e = 0$ and $\hat{\gamma}(F,N)$. Thus, for $\alpha_s > \underline{\alpha}_4(\lambda)$, $\hat{\gamma}(S,E) < B$. Similarly it is easy to see that for $\alpha_s > \underline{\alpha}_3(\lambda)$, $\hat{\gamma}(F,E) < B$ while for $\alpha_s > \underline{\alpha}_2(\lambda)$, $\hat{\gamma}(S,N) < B$. Finally,

$$\hat{\gamma}(F,N) = \frac{\gamma \Pr(x_s > x_s^*(\mathbf{1}_L, 1, \lambda)|F)}{\gamma \Pr(x_s > x_s^*(\mathbf{1}_L, 1, \lambda)|F) + (1-\gamma)\frac{\lambda}{2}} \underset{\alpha_s\to\infty}{\to} \frac{\gamma}{\gamma + (1-\gamma)\frac{\lambda}{2}},$$

which is again identical to the case for $p_e = 0$ and $\hat{\gamma}(S,N)$. Thus, for $\alpha_s \geq \underline{\alpha}_1(\lambda)$, $\hat{\gamma}(F,N) \geq B$. Now, for $\alpha_s \geq \underline{\alpha}_I(\lambda)$, we can write the payoffs for unskilled institutions from engaging as follows:

$$\Pr(S) P_h + (1 - \Pr(S))P_l - c_s,$$

whereas payoffs from not engaging are

$$\Pr(S) P_h + (1 - \Pr(S))(P_l + R).$$

Since $\Pr(S)\,P_h + (1-\Pr(S))\,(P_l + R) > \Pr(S)\,P_h + (1-\Pr(S))P_l$, $p_e = 1$ can never be a best response to $x_s^*(1,\lambda)$.

Finally, we show that $p_e \in (0,1)$ also cannot arise in equilibrium. For $p_e \in (0,1)$ the posteriors are given by the general expressions above. Note that since $\hat{\gamma}(F,E)$ and $\hat{\gamma}(S,N)$ are bounded in p_e, there exist $\underline{\alpha}_5(\lambda) \in \mathbb{R}_+$ and $\underline{\alpha}_6(\lambda) \in \mathbb{R}_+$ such that, for any p_e, for $\alpha_s \geq \underline{\alpha}_5(\lambda)$, $\hat{\gamma}(F,E) < B$ and for $\alpha_s \geq \underline{\alpha}_6(\lambda)$, $\hat{\gamma}(S,N) < B$. Now consider $\alpha_s \geq \underline{\alpha}_{II}(\lambda) := \max[\underline{\alpha}_5(\lambda), \underline{\alpha}_6(\lambda)]$. For any $p_e \in (0,1)$, λ:

$$\lim_{\alpha_s \to \infty} \hat{\gamma}(S,E) = \frac{A_s\gamma}{A_s\gamma + \left(A_s(1-\gamma)(1-\lambda) + \hat{A} - A_s\right)p_e + A_s(1-\gamma)\frac{\lambda}{2}}.$$

Either:

Case A: there exists a $\overline{p}_e > 0$ such that $\lim_{\alpha_s \to \infty} \hat{\gamma}(S,E) > B$ for $p_e \leq \overline{p}_e$ or

Case B: There exists no such $\overline{p}_e > 0$.

First, consider Case B. Note first that since $\hat{\gamma}(S,E)$ is increasing in $\Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda)\,|S)$ and $\Pr(x_s \leq x_s^*(\mathbf{1}_L, p_e, \lambda)\,|S)$ is increasing in α_s, $\hat{\gamma}(S,E) < B$ for all α_s.Thus, for any $\alpha_s > \underline{\alpha}_{II}(\lambda)$, the payoff to engaging is $\Pr(S)\,P_h + (1-\Pr(S))P_l - c_s$. But the payoff to not engageing is never less than $\Pr(S)\,P_h + (1-\Pr(S))P_l$. Thus, $p_e \in (0,1)$ cannot arise in equilibrium.

Now consider Case A. Given the argument for Case B, $p_e > \overline{p}_e$ cannot arise in equilibrium either. The only possibility is that $p_e \in (0, \overline{p}_e]$. Fix such a p_e, and suppose there exists some $\alpha_s \geq \underline{\alpha}_{II}(\lambda)$ such that for such a pair (p_e, α_s) we have $\hat{\gamma}(S,E) > B$. There are two possibilities:

Either for that (p_e, α_s), $\hat{\gamma}(F,N) \leq B$, in which case the payoffs to engaging are:

$$\Pr(S)\,(R + P_h) + (1-\Pr(S))P_l - c_s,$$

whereas payoffs from not engaging are

$$\Pr(S)\,P_h + (1-\Pr(S))P_l.$$

Having, $p_e \in (0,1)$ requires that

$$\Pr(S) = \frac{c_s}{R},$$

which is impossible because $\Pr(S) < \frac{1}{2}$ and $\frac{c_s}{R} \geq \frac{1}{2}$.

The other possibility is that for that (p_e, α_s), $\hat{\gamma}(F, N) > B$ in which case the payoffs to engaging are

$$\Pr(S)(R + P_h) + (1 - \Pr(S))P_l - c_s,$$

whereas payoffs from not engaging are

$$\Pr(S) P_h + (1 - \Pr(S))(P_l + R).$$

Having, $p_e \in (0,1)$ requires that

$$\begin{aligned} \Pr(S) R - c_s &= (1 - \Pr(S))R \\ \text{i.e., } \Pr(S) &= \frac{1}{2} + \frac{c_s}{2R}, \end{aligned}$$

which is again impossible because $\Pr(S) < \frac{1}{2}$. Thus, for any λ and $\alpha_s \geq \underline{\alpha}_{II}(\lambda)$, $p_e \in (0,1)$ cannot arise in equilibrium.

Defining $\underline{\alpha}_{III}(\lambda) := \max\left[\underline{\alpha}_I(\lambda), \underline{\alpha}_{II}(\lambda)\right]$ completes the proof of the Lemma.□

For the remainder of the proof, consider $\lambda < \min\left[\frac{2\gamma(1-B)}{(1-\gamma)B}, \frac{2(B-\gamma)}{(1-\gamma)B}\right]$ and $\alpha \geq \underline{\alpha}_{III}(\lambda)$, so that we can use the above characterisation of the strategies of unskilled institutions. Consider the putative equilibrium thresholds for the skilled institutions which are given by $x_s^*(0, \lambda)$. The payoffs from engagement are given by:

$$\Pr(\eta \leq \eta_s^*(\mathbf{1}_L, 0, \lambda) | x_{s,j})(R + P_h) + (1 - \Pr(\eta \leq \eta_s^*(\mathbf{1}_L, 0, \lambda) | x_{s,j})) P_l - c_s,$$

whereas the payoffs from non-engagement are given by:

$$\Pr(\eta \leq \eta_s^*(\mathbf{1}_L, 0, \lambda) | x_{s,j}) P_h + (1 - \Pr(\eta \leq \eta_s^*(\mathbf{1}_L, 0, \lambda) | x_{s,j})) P_l.$$

Thus, the net expected payoff from engagement is given by

$$\Pr(\eta \leq \eta_s^*(\mathbf{1}_L, 0, \lambda) | x_{s,j}) R - c_s$$

which is clearly decreasing in $x_{s,j}$. The existence of the dominance regions and continuity jointly imply that there exists $x_s^*(0,\lambda) \in \mathbb{R}$ such that

$$\Pr\left(\eta \leq \eta_s^*(\mathbf{1}_L, 0, \lambda)\,|x_s^*(\mathbf{1}_L, 0, \lambda)\right) R - c_s = 0.$$

Further, since $\eta|x_{s,j} \sim N\left(\frac{\alpha_\eta \mu_\eta + \alpha_s x_{s,j}}{\alpha_\eta + \alpha_s}, \frac{1}{\alpha_\eta + \alpha_s}\right)$, we have the following condition:

$$\Phi\left(\sqrt{\alpha_\eta + \alpha_s}\left(\eta_s^*(\mathbf{1}_L, 0, \lambda) - \frac{\alpha_\eta \mu_\eta + \alpha_s x_s^*(\mathbf{1}_L, 0, \lambda)}{\alpha_\eta + \alpha_s}\right)\right) = \frac{c_s}{R}. \tag{5}$$

Solving (4) for $x_s^*(\mathbf{1}_L, 0, \lambda)$ at $p_e = 0$ gives

$$x_s^*(\mathbf{1}_L, 0, \lambda) = \eta_s^*(\mathbf{1}_L, 0, \lambda) + \frac{1}{\sqrt{\alpha_s}}\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L, 0, \lambda) - \mathbf{1}_L A_L - A_s(1-\gamma)\frac{\lambda}{2}}{A_s \gamma}\right).$$

Substituting into (5) gives:

$$\Phi\left(\sqrt{\alpha_\eta + \alpha_s}\left(\eta_s^*(\mathbf{1}_L, 0, \lambda) - \frac{\alpha_\eta \mu_\eta + \alpha_s\left(\eta_s^*(\mathbf{1}_L, 0, \lambda) + \frac{1}{\sqrt{\alpha_s}}\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L, 0, \lambda) - \mathbf{1}_L A_L - A_s(1-\gamma)\frac{\lambda}{2}}{A_s\gamma}\right)\right)}{\alpha_\eta + \alpha_s}\right)\right) = \frac{c_s}{R},$$

$$\text{i.e., } \Phi\left(\eta_s^*(\mathbf{1}_L, 0, \lambda)\frac{\alpha_\eta}{\sqrt{\alpha_\eta + \alpha_s}} - \frac{\alpha_\eta \mu_\eta}{\sqrt{\alpha_\eta + \alpha_s}} - \frac{\sqrt{\alpha_s}}{\sqrt{\alpha_\eta + \alpha_s}}\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L, 0, \lambda) - \mathbf{1}_L A_L - A_s(1-\gamma)\frac{\lambda}{2}}{A_s\gamma}\right)\right) = \frac{c_s}{R}. \tag{6}$$

Taking the derivative of this relative to $\eta_s^*(\mathbf{1}_L, 0, \lambda)$ we obtain:

$$\phi\left(\eta_s^*(\mathbf{1}_L, 0, \lambda)\frac{\alpha_\eta}{\sqrt{\alpha_\eta+\alpha_s}} - \frac{\alpha_\eta\mu_\eta}{\sqrt{\alpha_\eta+\alpha_s}} - \frac{\sqrt{\alpha_s}}{\sqrt{\alpha_\eta+\alpha_s}}\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L,0,\lambda) - \mathbf{1}_L A_L - A_s(1-\gamma)\frac{\lambda}{2}}{A_s\gamma}\right)\right) \times \left(\frac{\alpha_\eta}{\sqrt{\alpha_\eta+\alpha_s}} - \frac{\sqrt{\alpha_s}}{\sqrt{\alpha_\eta+\alpha_s}}\frac{1/A_s\gamma}{\phi\left(\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L,0,\lambda) - \mathbf{1}_L A_L - A_s(1-\gamma)\frac{\lambda}{2}}{A_s\gamma}\right)\right)}\right).$$

As $\alpha_s \to \infty$ the above expression reduces to

$$\phi\left(-\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L, 0, \lambda) - \mathbf{1}_L A_L - A_s(1-\gamma)\frac{\lambda}{2}}{A_s\gamma}\right)\right)\left(-\frac{1/A_s\gamma}{\phi\left(\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L,0,\lambda) - \mathbf{1}_L A_L - A_s(1-\gamma)\frac{\lambda}{2}}{A_s\gamma}\right)\right)}\right) < 0.$$

Continuity in α_s implies that there exists an $\underline{\alpha}_{IV}(\lambda) \in \mathbb{R}_+$ such that for $\alpha \geq \underline{\alpha}_{IV}(\lambda)$, the left hand side of (6) is monotone in $\eta_s^*(\mathbf{1}_L, 0, \lambda)$. Thus there can be only one solution $\eta_s^*(\mathbf{1}_L,0,\lambda)$. Existence of a solution can be verified by taking the limit of (6) as $\alpha_s\to\infty$:

$$\Phi\left(-\Phi^{-1}\left(\frac{\eta_s^*(\mathbf{1}_L,0,\lambda)-\mathbf{1}_LA_L-A_s(1-\gamma)\frac{\lambda}{2}}{A_s\gamma}\right)\right)=\frac{c_s}{R},$$

so that

$$\eta_s^*(\mathbf{1}_L,0,\lambda)=\mathbf{1}_LA_L+A_s\gamma\left(1-\frac{c_s}{R}\right)+A_s(1-\gamma)\frac{\lambda}{2}.$$

The proof is completed by setting $\underline{\alpha}(\lambda):=\max\left[\underline{\alpha}_{III}(\lambda),\underline{\alpha}_{IV}(\lambda)\right]$.■

Proof of Lemma 1: Existence follows immediately, because for $K_2^*(A_L,\Delta)=0$ the left hand side is bigger than the right hand side, whereas, since $R-c_s<(1-\delta)\gamma\overline{k}$, for $K_2^*(A_L,\Delta)=\Delta\gamma\overline{k}$ the left hand side is smaller than the right hand side. Since $\eta\sim N\left(\mu_\eta,\sigma_\eta^2\right)$, taking the derivative with respect to $K_2^*(A_L,\Delta)$ of the left hand side gives:

$$\frac{1}{\Delta\gamma\overline{k}}\frac{(R-c_s)^2}{R}\phi_{\mu_\eta,\sigma_\eta^2}\left(A_L+\gamma\frac{K_2^*(A_L,\Delta)}{\Delta\gamma\overline{k}}\left(1-\frac{c_s}{R}\right)\right)>0.$$

Since $\phi_{\mu_\eta,\sigma_\eta^2}(\cdot)<\frac{1}{\sqrt{2\pi}\sigma_\eta}$, for any given Δ, $\overline{k}$, R, γ, and c_s, there exists a $\underline{\sigma}_\eta\in\mathbb{R}_+$ such that if $\sigma_\eta\geq\underline{\sigma}_\eta$ the rate of increase of the left hand side is strictly smaller than 1, the rate of increase of the right hand side. Then, the intersection point is unique.■

Proof of Proposition 2: When $\sigma_\eta\geq\underline{\sigma}_\eta$, $K_2^*(0,\Delta)$ is uniquely defined by (2) while $K_2^*(A_L,\Delta)$ is uniquely defined by (1). Note first that for $A_L=0$, (2) coincides with (1), so that

$$K_2^*(A_L,\Delta)\,|_{A_L=0}=K_2^*(0,\Delta)\,.$$

Further note that the left hand side and right hand side of (1) are both increasing in $K_2^*(A_L,\Delta)$ but only the left hand side is increasing in A_L. This implies that $\frac{dK_2^*(A_L,\Delta)}{dA_L}>0$, so that $K_2^*(A_L,\Delta)>K_2^*(0,\Delta)$.■

Proof of Proposition 3: We first show that the threshold $K_2^*(A_L,\Delta)$ is decreasing in $\overline{k}$. Consider (1) which implicitly defines $K_2^*(A_L,\Delta)$. The result follows since the left hand side is clearly decreasing in $\overline{k}$ and increasing in $K_2^*(A_L, \Delta)$, while the right hand side is unaffected by $\overline{k}$.

Now note that each term in (3) is decreasing in $\overline{k}$ and increasing in $K_2^*(A_L, \Delta)$, which in turn is decreasing in $\overline{k}$.■

References

Admati, A., Pfleiderer, P., 2009. The Wall Street Walk and shareholder activism: exit as a form of voice. Review of Financial Studies 22, 2645–2685.

Attari, M., Banerjee, S., Noe, T., 2006. Crushed by a rational stampede: strategic share dumping and shareholder insurrections. Journal of Financial Economics 79, 181–222.

Bebchuk, L., Brav, A., Jiang, W., 2013. The long-term effects of hedge fund activism. Columbia Law Review, forthcoming.

Bolton, P., von Thadden, E-L., 1998. Blocks, liquidity, and corporate control. Journal of Finance 53, 1–25.

Brav, A., Jiang, W., Partnoy, F., Thomas, R., 2008. Hedge fund activism, corporate governance, and firm performance. Journal of Finance 63, 1729–1775.

Brav, A., Jiang, W., Kim, H., 2010. Hedge Fund Activism: A Review. Foundations and Trends in Finance 4, 185-246.

Briggs, T., 2006. Corporate governance and the new hedge fund activism: An empirical analysis. Journal of Corporation Law 32, 681-738.

Burkart, M., Gromb, D., Panunzi, F., 1997. Large shareholders, monitoring, and the value of the firm. Quarterly Journal of Economics 112, 693–728.

Carlsson, H., van Damme, E., 1993. Global Games and Equilibrium Selection. Econometrica, 61, 989-1018.

Coffee, J., Palia, D., 2014. The Impact of Hedge Fund Activism: Evidence and Implications. ECGI Law Working Paper No. 266/2014.

Cohn, J., Rajan, U., 2012. Optimal corporate governance in the presence of an activist investor. Unpublished working paper. University of Texas and University of Michigan.

Cunat, V., Gine, M., Guadalupe, M. 2013. The Vote is Cast: The Effect of Corporate

Governance on Shareholder Value, Journal of Finance, 67, 1943-1977.

Corsetti, G., Dasgupta, A., Morris, S., Shin, H. 1994. Does one Soros make a difference? A theory of currency crises with large and small traders. Review of Economic Studies 71, 87-114.

Dasgupta, A., Piacentino, G., 2015. The Wall Street Walk when blockholders compete for flows. Journal of Finance, 70, 2853–2896.

Dasgupta, A., Prat, A., 2008. Information aggregation in financial markets with career concerns. Journal of Economic Theory 143, 83–113.

Doidge, C., Dyck, A., Mahmudi, H., Virami, A., 2015, Can Institutional Investors Improve Corporate Governance Through Collective Action?, Working Paper, University of Toronto.

Edmans, A., 2009. Blockholder trading, market efficiency, and managerial myopia. Journal of Finance 64, 2481–2513.

Edmans, A., 2011. Short-term termination without deterring long-term investment: a theory of debt and buyouts. Journal of Financial Economics 102, 81–101.

Edmans, A., Manso, G., 2011. Governance through trading and intervention: a theory of multiple blockholders. Review of Financial Studies 24, 2395–2428.

Faure-Grimaud, A., Gromb, D., 2004. Public trading and private incentives. Review of Financial Studies 17, 985–1014.

Gaurav, J., Ji, X., 2015. Wolf Pack Activism: A Quick Look, Analysis Group, Web.

Gillan, S., Starks, L., 2007. The evolution of shareholder activism in the United States. Journal of Applied Corporate Finance 19, 55-73.

Kahn, C., Winton, A., 1998. Ownership structure, speculation, and shareholder intervention. Journal of Finance 53, 99–129.

Klein, A. Zur, E., 2009. Entrepreneurial Shareholder Activism: Hedge Funds and

Other Private Investors. Journal of Finance, 64, 187–229.

Kovbasyuk, S., Pagano, M., 2014, Advertising Arbitrage, Working Paper, EIEF.

Kyle, A., Vila, J., 1991. Noise trading and takeovers. RAND Journal of Economics 22, 54–71.

Lipton, M., 2015. The Threat to Shareholders and the Economy from Activist Hedge Funds. Harvard Law School Forum on Corporate Governance and Financial Regulation (Blog Posting 1/14/2015)

Maug, E., 1998. Large shareholders as monitors: is there a trade-off between liquidity and control? Journal of Finance 53, 65–98.

McCahery, J., Sautner, Z. Starks, L. 2014. Behind the scenes: The corporate governance preferences of institutional investors, Unpublished Manuscript.

Morris, S., Shin, H. 1998. Unique equilibrium in a model of self-fulfilling currency attacks. American Economic Review 88, 587-597.

Morris, S., Shin, H. 2002. Global games: Theory and applications. In Dewatripont, M. Hansen, L., Turnovsky S. (Eds.), Advances in Economics, and Econometrics the Eighth World Congress, Cambridge University Press, Cambridge, UK, 2002, 56–114.

Nathan, C., 2009. Recent Poison Pill Developments and Trends. Harvard Law School Forum on Corporate Governance and Financial Regulation (Blog Posting 5/12/2009)

Noe, T., 2002. Investor activism and financial market structure. Review of Financial Studies15, 289-318.

Piacentino, G. 2013. Do institutional investors improve capital allocation? Unpublished Manuscript.

Shleifer, A., Vishny, R., 1986. Large shareholders and corporate control. Journal of Political Economy 94, 461–488.

Smilan, L., Becker, D., Holbrook, D., 2006. Preventing 'wolf pack' attacks. National

Law Journal 11/20/2006.

Zwiebel, J., 1995. Block investment and partial benefits of control. Review of Economic Studies 62, 161–185.