

Corporate Reputational Dynamics, Private Regulation, and Activist Pressure¹

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Abstract

We model the interaction between a profit-maximizing firm and an activist using an infinite-horizon dynamic stochastic game. The firm enhances its reputation through a form of private regulation: voluntary provision of an activity that reduces a negative externality. We show that in equilibrium the externality-reducing activity is subject to decreasing marginal returns, which can cause the firm to “coast on its reputation,” i.e., decrease the level externality-reducing activity as its reputation grows. The activist, which benefits from increases in the externality-reducing activity, can take two types of action that can harm the firm’s reputation: *criticism* (comprising tactics such as letter-writing campaigns or Facebook pages that call attention to the firm’s flaws), which can impair the firm’s reputation on the margin, and *confrontation*, which can trigger a crisis that may severely damage the firm’s reputation. An increase in the probability of a crisis in a given reputational state has the direct effect of decreasing the firm’s externality-reducing activity in that state. But the activist changes the reputational dynamics of the game by tending to keep the firm in reputational states in which it is highly motivated to invest in externality-reducing activity. The paper provides both a positive and normative theory of anti-corporate activism. Using computational analysis, criticism and confrontational activity are shown to be imperfect substitutes. The more patient the activist and/or the more passionate it is about externality reduction, the more likely it is to rely on confrontation. The more patient the firm and the more important corporate citizenship is to firm’s brand equity, the more likely that it will be targeted by an activist that relies on confrontation. Both the long-run and the discounted net social benefit from externality reduction tend to increase due to the presence of the activist, but generally not to levels that exceed the first best level. In this sense, the activist’s impact on private regulation can make it a positive force for social welfare when public regulation is ineffective or impossible.

1 Introduction

The regulation of economic activity is one of the main arenas of political competition. The impetus for changes to regulatory regimes frequently originates with concerned citizens, often motivated by social or ethical concerns. Traditionally, concerned citizens have used public institutions such as legislatures, executive agencies, and courts to advance their agenda. In recent years, however, many activists have concluded that public processes respond too slowly and can be blocked too easily by special interests. In response they have turned to “private politics” instead. Private politics refers to actions by private interests such as activists that target private agents, typically firms, often in the institution of public sentiment (Baron 2001, Baron 2003, Baron and Diermeier 2007, Feddersen and Gilligan 2001). Issues have included, among others, environmental protection, human rights, discrimination, privacy, safety of employees and customers, endangered species, and animal welfare testing. The activists’ explicit or implicit goal is *private regulation*, i.e. the “voluntary” adoption of rules that constrain certain company conduct without the involvement of public agents.¹ Michael Brune, executive director of the Rainforest Action Network (RAN), a leading global activist group, commented that “Companies were more responsive to public opinion than certain legislatures were. We felt we could create more democracy in the marketplace than in the government.” (Baron and Yurday 2004). If successful, such strategies may lead to alternative, private governance mechanisms. Examples are the Equator Principles or the Sustainable Forestry Initiative.²

The actions of activist groups center on a corporate campaign, the organizational framework for satisfying activists’ goals. In a campaign an activist group tries to affect the business practices of a target firm through a combination of threatened harms and promised rewards (e.g. Baron and Diermeier 2007). Harm usually takes the form of damage to the company’s reputation though more direct actions (e.g., disrupting certain operations) are not uncommon. Similarly, rewards may come in the form of endorsements that enhance a company’s reputation.

Activists pursue different goals and use different tactics. While some are quite radical and use confrontational means, others are more moderate and use a combination of criticism and engagement. One such confrontational approach is to try to create a reputational crisis that has a significant impact on the company’s image, as in the confrontation between the activist group Greenpeace and Royal Dutch/Shell over the disposal of the Brent Spar oil storage buoy (Diermeier 1995). In that example Greenpeace occupied the platform in the middle of the North Sea. Shell then decided to clear it using water canons, which led to a media storm and drops in sales of up to 40 percent across Northern Europe.

This paper focuses on modeling a campaign in a dynamic context between a firm that cares (to some extent) about its image as a good citizen and an activist that seeks to tarnish the firm’s image to advance its own agenda. The firm can enhance its image by engaging in private regulation,

¹Maxwell, Lyon, and Hackett (2001) call this self regulation. Vogel (2010) presents the closely related idea of civil regulation.

²For an overview of such governance models see Koppell (2010).

modeled here as voluntary activity aimed at curbing a negative externality, above and beyond that required by or incentivized by public policy. The activist group can target the firm in two ways. It can engage in effort that counteracts the firm’s efforts to improve its reputation through private regulation. Or it can try to trigger a crisis that can drastically harm the firm’s reputation.

We model the interaction between the firm and the activist as a discrete-time, infinite-horizon dynamic stochastic game involving a firm and an activist. Though we provide some analytical characterization of the Markov perfect equilibrium of this game, we rely heavily on computational methods because, as we show, the activist’s impact on firm behavior is complex and subtle. In particular, we employ the homotopy method utilized in Besanko, Doraszelski, Kryukov, and Satterthwaite (2010) to show how equilibrium behavior is affected by the fundamentals of the model, including the efficacy of the activist, the discount factors, and the returns to corporate citizenship. The efficacy of the activist is affected by two factors: the saliency of the activist’s campaign to call attention to the firm’s shortcomings (what we call *criticism*) and the newsworthiness of the activist’s efforts to provoke a crisis (what we call *confrontation*). Criticism harms the firm’s reputation at the margin, while confrontation—if it becomes newsworthy—can drastically hurt the firm’s reputation. Increases in salience (holding newsworthiness constant) are shown to induce a substitution, in the long run, of confrontation for criticism, while increases in newsworthiness (holding salience constant) induces substitution of effort in the opposite direction. Thus, fundamentally, criticism and confrontation are substitutes.

We further show that an activist with a higher discount factor — i.e., a more patient activist — tends to rely to a greater extent on confrontation than one with a lower discount factor. Since the discount factor is driven, in part, by the likelihood that the activist persists over time, our model suggests that, all other things equal, crisis provocation is a tool more likely to be used by a secure and well-funded activist than by one who knows it may not be around in the future. We also find that the firm’s long-run value declines significantly as the activist’s discount factor increases. Moreover, a firm with a higher discount factor is more susceptible to a crisis than a firm with a lower discount factor and that the activist derives more long-run value when the firm has a high discount factor than when it has a low discount factor. Thus, the most dangerous adversary for a firm is a patient activist, and the most inviting target for an activist is a patient firm.

Our paper has both positive and normative implications. As just noted, the model illustrates circumstances under which an activist would tend to rely more on confrontation or criticism, and thus it provides a positive theory of activist behavior. In addition, the model helps resolve a puzzle: why do firms like Coca Cola, Cisco Systems, or McDonalds—firms with established brands and multi-billion market capitalizations—devote the same or increasing resources, year after year, to voluntary efforts that address social problems such as carbon emissions or obesity, even when it is hard to imagine how such activity could make their very strong brands even stronger? It seems plausible that this activity would reach a point of diminishing marginal returns, making increased levels of it inconsistent with shareholder value maximization.

One way to resolve this puzzle is to invoke a theory of moral management of the kind developed by Baron (2009a). Another way to resolve it is through agency arguments: senior managers who authorize spending on corporate citizenship do so to burnish their own private reputations, rather than enhance shareholder wealth, and equilibrium contracting may be unable to eliminate this form of perquisite consumption entirely. Our model, by contrast, provides a different explanation for the puzzle that does not require abandoning the assumption of shareholder wealth maximization. Specifically, it suggests that in a modern media and communications environment, corporate reputation is subject to both countervailing pressures and drastic shocks that, at least to some extent, can be engineered by activists. These pressures and shocks boost private regulation by keeping a firm in situations where the accumulation of additional reputational capital has significant value. A potential social value of an activist, then, is to keep the firm well below the point at which diminishing marginal returns would induce it to scale back its voluntary activity.

The normative implications of the paper are related to the examination of this social value. One might wonder whether activists might induce a level of private regulation that goes too far and exceeds the socially efficient level. On the other hand, the harm that the activist can impose on the firm's reputation could also suppress private regulation by making reputational capital less valuable to acquire in the first place, so conceivably the level of private regulation induced would not only fall short of the socially efficient level, but would result in a level of welfare that is less than what would arise in the absence of the activist.

Our computational analysis shows the expected long-run level of externality-reducing activity is typically greater than zero (the level that would arise in the absence of an activist) but less than the first-best level that maximizes the net social benefit of externality-reducing activity. Thus, the presence of the activist enhances social efficiency in the long run. However, in the short run, the activist's presence can decrease the net benefit from externality reduction if the activist is sufficiently passionate. On balance, though, we find that the discounted net social benefit of externality reduction tends to be greater with an activist than without one. Our welfare results thus suggest that the activist can be a positive force for society, perhaps especially in circumstances in which public regulation is either infeasible or operates poorly because of corruption or other governance problems.

The organization of the remainder of the paper is as follows. Section 2 describes the model of competition between the firm and the activist. Section 3 and presents the general conditions for equilibrium. Section 4 explains the computational approach we employ and the baseline parameters we use in those computations. Section 5 provides some analytical characterization of the Markov perfect equilibrium and also presents the results of our computational analysis. Section 6 explores the welfare implications of the equilibrium interaction between the firm and the activist. Section 7 summarizes and concludes. Throughout the paper we distinguish between "Propositions" that are established through formal arguments and "Results," which either establish a possibility through a numerical example or summarize a regularity revealed through a systematic exploration of the

parameter space. Proofs of all propositions are in the Appendix.

2 The model

2.1 Model structure

The basic structure of our model is one of competition between a firm and an activist group. Put simply, the firm seeks to enhance its reputation for corporate citizenship, while the activist takes steps to undermine that image.³ We model this competition as an infinite horizon dynamic game.

2.1.1 The firm

The firm produces a single product which has a demand curve $q_t = e_t - p_t$, where q is quantity at time t , p_t is price, and e_t is the strength of the firm’s overall brand equity. We assume that brand equity is given by $e_t = e_0 R_t^\theta$, where e_0 is a fixed component (determined by factors such as product performance or design), and R_t is the firm’s reputation for corporate citizenship (hereafter referred to as “reputation”). The importance of reputation is captured by the parameter $\theta > 0$.

Our model is set in discrete time and has a discrete state space $\mathcal{R} = \{1, \dots, \bar{R}\}$.⁴ The firm’s initial reputation is $R_0 \in (1, \bar{R})$.⁵ We assume that R_t is influenced by activities of the firm and the activist group and evolves according to the following stochastic process:

$$R_{t+1} = \begin{cases} R_t + \tilde{F}_t - \tilde{A}_t & \text{if } \tilde{\Delta}_t = 0 \\ \in \{1, \dots, \max\{R_t - 1, 1\}\} & \text{if } \tilde{\Delta}_t = 1, \end{cases} \quad (1)$$

where, \tilde{F}_t , \tilde{A}_t , and $\tilde{\Delta}_t$ are random variables taking on values $\{0, 1\}$. The firm’s reputation for corporate citizenship evolves in two ways. If $\tilde{\Delta}_t = 0$, reputation evolves incrementally, moving up or down by one unit depending on the realizations of \tilde{A}_t and \tilde{F}_t (both of which we discuss below). By contrast, if $\tilde{\Delta}_t = 1$, the firm’s reputation can drop precipitously. In particular, if $\tilde{\Delta}_t = 1$, reputation will fall to a particular value between 1 and $\max\{R_t - 1, 1\}$ according to a uniform distribution. We characterize this event as a crisis. A crisis can cause a firm’s reputation for citizenship to take a potentially significant one-time “hit,” which equals $\frac{R_t}{2}$ on average. This formulation captures a “bigger they are, the harder they fall” property: firms with greater reputations for citizenship will, on average, experience a greater *absolute drop* in reputation as a result of a crisis. This is consistent

³In the model activists can only harm the firm’s reputation, they cannot improve it, e.g. by endorsing the firm’s business practices and products. Much of the empirical literature on activists has pointed out that activists focus on inducing harm (e.g. Friedman 1999). While we follow this approach here, future work may enlarge the strategy set for activists to include providing benefits for the firm and then provide an equilibrium analysis to explain the prevalence of harm. For a discussion and a static model with both harm and benefits see Baron and Diermeier (2007)

⁴The upper bound \bar{R} contributes to diminishing marginal return to investments in reputation building, but as illustrated below it is not the only source of diminishing marginal returns in the model. Diminishing marginal returns to investment in reputation building is supported by empirical evidence; see, for example, Lev, Petrovits, and Radhakrishnan (2006) on the impact of corporate charitable contributions on sales growth.

⁵ R_0 does not affect the equilibrium, but it does affect the transient (short-run) dynamics implied by the equilibrium.

with the observation that companies with the strongest reputations for citizenship tend to receive the greatest scrutiny by activists and the media, and thus seem to have the greatest vulnerability in the event of a crisis.⁶ An alternative view (e.g. Dowling 2002, Alsop 2004) is that firms that have invested heavily in building a reputation for citizenship may have a “bank account” that can cushion the impact of the reputational shock from the crisis. In the model this is captured by the feature that the *proportionate drop* in a firm’s reputation is independent of R (on average it is 50 percent). Thus, a firm with a strong reputation is cushioned to some extent from the impact of a crisis.⁷

The firm’s production process creates externalities that are neither regulated nor priced in the market. The firm can positively affect its reputation by engaging in a level x_t of voluntary externality-reducing activity that goes beyond the level it is legally required to undertake in the jurisdictions in which it operates.⁸ This would be especially relevant for firms whose supply chains are located in parts of the world where conventional regulatory mechanisms are either unavailable or ineffective and that lack markets to price the negative externality. As such, the externality-reducing activity occurs in the realm of what Baron (2003) refers to as private politics, and we refer to it as private regulation.

Potential consumers do not observe x_t , but x_t generates an imperfect signal \tilde{X}_t which, if it exceeds a threshold X_0 , creates awareness among consumers that the firm is voluntarily taking steps to reduce an externality. From this, the firm gets credit for being a good citizen, which incrementally enhances its reputation, i.e., $\tilde{F}_t = 1$. We assume \tilde{X}_t has a logistic distribution with mean $\ln(x)$ and scale parameter 1, so

$$\phi_F(x_t) \equiv \Pr(\tilde{F}_t = 1|x_t) = \frac{\eta x_t}{1 + \eta x_t},$$

and $\eta \equiv \exp(-X_0) > 0$. The function $\phi_F(\cdot)$ takes on values between 0 and 1 for all positive values of x ; it is strictly increasing and concave, and approaches 1 as x becomes arbitrarily large.

We assume that externality-reducing activity does not affect the performance, quality, or appearance of the firm’s products. Therefore, although the activity creates a direct *social* benefit, it has no direct *consumer* benefit and thus does not enter the firm’s demand function. The provision of x is assumed to increase the firm’s total costs, which are given by $cq + kx$, where $c \in (0, e_0)$ is the marginal cost of output and $k > 0$ is the marginal cost of externality-reducing activity.

⁶See Argenti (2004). Dean (2004) provides experimental evidence that supports this phenomenon.

⁷Note that by changing assumptions on the distribution over 1 and $\max\{R - 1, 1\}$ in the event of a crisis, we can change the implicit strength of the “bigger they are, harder they fall” property and the “bank account” property.

⁸For simplicity, we normalize required regulatory compliance to be 0.

2.1.2 The activist

Unlike the firm, the activist internalizes direct benefits from x . The social benefit of x is denoted by $w(x)$ and is given by:

$$w(x) = \begin{cases} w_0x - \frac{1}{2}w_1x^2 & x \leq \frac{w_0}{w_1} \\ \frac{w_0^2}{2w_1} & \text{otherwise} \end{cases}.$$

The activist's private utility is given by $u(x) = \psi w(x)$, where $\psi \geq 0$ is a parameter that measures the activist's passion for the social benefits created by x . If $\psi > 1$, activist is so passionate that it over-internalizes the social benefits of externality-reduction.

Offsetting the firm's efforts to build its reputation, the activist can harm the firm's reputation in two distinct ways. First, the activist group can engage in *criticism*, denoted by z . Criticism comprises things such as letters to editors, op-ed pieces, letter-writing campaigns, share-holder resolutions, Facebook groups, and blogs that publicly call attention to the firm's shortcomings and which may, therefore, counteract the firm's attempt to burnish its image through private regulation. In each period, criticism influences a signal \tilde{Z}_t which can damage the image of the firm if it exceeds a threshold Z_0 beyond which the activist's criticism penetrates the public consciousness. Thus, $\tilde{A}_t = 1$ if and only if $\tilde{Z}_t \geq Z_0$. We assume that \tilde{Z}_t has a logistic distribution with mean $\ln(z)$ and scale parameter 1, so

$$\phi_A(z_t) \equiv \Pr(\tilde{A}_t = 1|z_t) = \frac{\alpha z_t}{1 + \alpha z_t},$$

where $\alpha \equiv \exp(-Z_0) > 0$.

Second, the activist group can engage in *confrontation*, denoted by d . Confrontation is deliberately aimed at provoking a reputational crisis. In each period, confrontation creates a level \tilde{D}_t of potentially newsworthy negative publicity about the firm's activities. The publicity need not be accurate; what matters is that it is potentially newsworthy enough to attract mass media attention. Once \tilde{D}_t exceeds a newsworthiness threshold D_0 , the publicity "blows up" and develops into a crisis.⁹ Thus, $\tilde{\Delta}_t = 1$ if and only if $\tilde{D}_t \geq D_0$. We assume that \tilde{D}_t has a logistic distribution with mean $\ln(d)$ and scale parameter 1, so

$$\phi_\Delta(d_t) \equiv \Pr(\tilde{\Delta}_t = 1|d_t) = \frac{\omega d_t}{1 + \omega d_t},$$

where $\omega \equiv \exp(-D_0) > 0$.

Criticism and confrontation work through different channels. The former is more constructive and intended on changing business practices. It frequently does not generate significant coverage by the mass media. Religious organizations and pensions funds, e.g. TIAA-CREF, commonly pursue this approach, but it is also in the arsenal of many activists groups (e.g. Eesley and Lenox, 2006). By contrast, confrontation is intended to generate significant mass media coverage, critical to the firm. The general idea is to create a spectacle through acts of civil disobedience (e.g. occupying

⁹For a discussion of the underlying processes see Baron (2009b) and Diermeier (2011), especially Chapters 1-3.

an installation or throwing a pie at the CEO), theatrical protests (e.g. dressing up as a polar bear to protest global warming), and other forms of confrontation (e.g. posting “wanted posters” in the CEOs community).¹⁰ In his handbook for activists, San Francisco low-rent-housing advocate Randy Shaw summarized the approach as follows:

“Ideally, tactical activists should use the media both to generate a scandal and then to demand a specific, concrete result.” (p.155).

The parameters α and ω capture the efficacy of each type of activity.¹¹ The parameter α depends on the salience of the activist’s efforts to draw attention to the firm’s shortcomings using non-confrontational tools such as blogs or op-ed pieces. It would thus be a function of the activist’s skill in developing a persuasive narrative that counters the firm’s efforts to burnish its reputation, as well as its effectiveness in mobilizing a community of followers to disseminate that narrative. It would also depend on the salience of the activist’s issue in a given market-place.¹² By contrast, the parameter ω depends on the mass media environment. For example, it would reflect the extent to which mass media outlets are inclined to provide coverage of the actions the activist group takes to provoke a crisis. The likelihood that the media will provide such coverage may depend on many factors such as the issue environment in a given country, the skill of the activists in generating media coverage, and the structure of the media, e.g. the importance of state-owned media.¹³ In a world without mass media, $\omega = 0$. Given the distinction between these parameters, we refer to α as the salience parameter and ω as the newsworthiness parameter.

Both z and d are costly to the activist, and the activist’s cost function is given by $b_z z + b_d d$, where $b_z > 0$ and $b_d > 0$ are constants. We normalize b_d by assuming that $b_d = b_d(R) = \frac{R}{2} b_z$. This specification ensures that the cost to the activist of obtaining one unit of reputation reduction through criticism is equal to the cost of obtaining, on average, one unit of reputation reduction through confrontation.¹⁴ We adopt this specification so as not to bias the choice between the two activities solely due to differences in their marginal costs. Any difference in the intensity of the activist’s critical and confrontational activities will be due to differences in α and ω or to the intrinsically different ways that the two activities affect reputational dynamics.

2.1.3 Comments on the model specification

1. The firm’s objective is the maximization of the discounted value of its profits. The firm thus has no intrinsic preference for engaging in externality-reducing activity. It does so only to

¹⁰For examples of such tactics see Diermeier (2011), Chapter 3.

¹¹For empirical studies of the impact of different forms of activism on firm behavior in the context of environmental pollution see Eesley and Lenox (2005), Eesley and Lenox (2006), and Lenox and Eesley (2009).

¹²For example, it has been hypothesized that a country’s concern about animal welfare may be systematically related to its economic growth. See Frank (2008).

¹³See Baron (2009b), Baron and Diermeier (2007) and Diermeier (2011) for details.

¹⁴Strictly speaking, this would be correct only if $\alpha = \omega$. By normalizing the cost parameters, we ensure that the difference between reputation-impairing and crisis-inducing effort is due either to differences in α and ω , or to fundamental differences in the nature of reputation-impairing activity and crisis-inducing activity.

improve its reputation and/or to blunt the effort of the activist.

2. The activist receives no intrinsic utility from harming the firm’s reputation: it cares only about the level of x provided by the firm. In this respect, the activist is “pragmatic.” Its benefit from harming the firm’s reputation is to keep the firm motivated to supply higher levels of x . In practice, activists may have ideological interests that translate into a direct utility for hurting firms’ reputations or financial conditions. Still, the pragmatic activist specification is plausible because we believe that to be effective an activist must be pragmatic to some extent. The pragmatic activist model is also a useful benchmark because it highlights the role of the activist as a strategic player in the firm’s reputation management process. (By contrast, purely ideological activists would merely be “noise.”)
3. R is assumed to be observable to the activist, and thus the activist can condition its actions on it. This may appear to be a strong assumption. Unlike a firm’s physical capital, installed base of customers, or cumulative experience, R is not a standard metric that would be followed by investment analysts. However, the media does give attention to firms’ reputations for corporate citizenship (often in the form of rankings). For example, for many years *Fortune* has published a list of “America’s Most Admired Corporations,” and one component of that ranking (used in empirical work on corporate reputation) is “Responsibility to the community and environment.”¹⁵ In addition, effective activists are likely to be skillful at sensing public sentiment about companies and tailoring their efforts to that sentiment. Finally, tools from computational linguistics and computer science provide technologies that enable individuals and groups to perform highly sophisticated content analysis of media and analyst coverage of firms to determine how their public image is being portrayed.¹⁶ In light of these considerations, the assumption that R is observable to the activist strikes us as plausible.
4. The firm cannot take actions *ex ante* to reduce the likelihood of a crisis. All the firm can do is to “plug away” and attempt to build its reputation over time (which, as noted above, provides a cushion in the event of a crisis). This captures the notion that a crisis is primarily a phenomenon that arises within, and plays itself out, in the context of the media. Within that realm, there are notable asymmetries between what activists and firms can do. Activists may be able to draw attention to problems that can provoke media scrutiny, but firms typically have less ability to influence the media “narrative” (Dennis and Merrill, 1996; Bond and Kirshenbaum, 1998). This arises because “good news” that a firm might want to highlight to prevent a crisis (e.g., Toyota solving problems with its accelerators) is typically less newsworthy than “bad news” that an activist might highlight to trigger a crisis (e.g., car crashes traceable to faulty accelerators).

¹⁵This ranking is now called the “World’s Most Admired Companies.”

¹⁶See, for example, Diermeier and Trapanier (2009) for an application of this technology to measure “shocks” to corporate reputations.

5. The firm and the activist group are assumed unable to contract on the provision of x , z , and d .¹⁷ In practice, of course, bargaining between activists and firms sometimes does occur, but there are various reasons why bargaining solutions may be infeasible. For example, some activist groups may be unwilling to strike deals with firms lest their volunteers or donors see them as “selling out. This effect will be particularly pronounced if the activist group competes in a market for donors with other groups less willing to compromise. Such competition may also make the enforcement of any agreement between a firm and an activist group impossible.¹⁸

3 Equilibrium conditions

We restrict attention to the Markov perfect equilibrium (MPE) in which the state variable is the firm’s reputation R . A MPE is a vector of strategies $\{(x^*(R), z^*(R), d^*(R)), R \in \mathcal{R}\}$ such that:

- For each state $R \in \{1, \dots, \bar{R}\}$, $x^*(R)$ maximizes the discounted present value of the firm’s expected profits, given the activist’s strategies $\{(z^*(R), d^*(R)), R \in \mathcal{R}\}$.
- For each state $R \in \{1, \dots, \bar{R}\}$, $(z^*(R), d^*(R))$ maximizes the discounted present value of the activist’s expected utility, given the firm’s strategy $\{x^*(R), R \in \mathcal{R}\}$.

3.1 Firm’s Bellman equation and Kuhn-Tucker conditions

With linear demand and constant marginal cost, the firm’s per-period profit contribution in state R is $\frac{(e_0 R^\theta - c)^2}{4}$. We assume that $\theta \in (0, \frac{1 - \frac{c}{2e_0}}{2 - \frac{c}{2e_0}})$, which implies that single-period profit is strictly concave in R .

Let $V_F^*(R)$ denote the present value of the firm’s expected profit in state R in equilibrium. It is defined by the Bellman equation

$$V_F^*(R) = \frac{(e_0 R^\theta - c)^2}{4} + \max_{x \geq 0} \left\{ -kx + \beta_F \left[1 - \phi_\Delta^*(R) \left\{ \begin{aligned} & \phi_F(x) [1 - \phi_A^*(R)] V_F^*(R+1) \\ & + [1 - \phi_F(x) - \phi_A^*(R) + 2\phi_F(x)\phi_A^*(R)] V_F^*(R) \\ & + [1 - \phi_F(x)] \phi_A^*(R) V_F^*(R-1) \\ & + \phi_\Delta^*(R) \frac{\sum_{r=1}^{\max\{R-1, 1\}} V_F^*(r)}{R-1} \end{aligned} \right\} \right] \right\}, \quad (2)$$

where $\beta_F \in (0, 1)$ is the firm’s discount factor, $\phi_A^*(R) \equiv \phi_A(z^*(R))$, and $\phi_\Delta^*(R) \equiv \phi_\Delta(d^*(R))$. In writing this expression, it is understood that in state $R = \bar{R}$, $V_F^*(R+1) = V_F^*(R)$ and in state $R = 1$, $V_F^*(R-1) = V_F^*(R)$.

Straightforward algebra reveals that the firm’s continuation value (the term in large square brackets in (2)) is a function of (among other things) $V_F^*(R) - V_F^*(R-1)$ and $V_F^*(R+1) - V_F^*(R)$.

¹⁷In this respect, our model differs from that of Baron (2006), which assumes that the target firm and the activist can negotiate over the firm’s provision of externality-reducing activity and the activist’s undertaking of a campaign against the firm.

¹⁸For a discussion of activist commitment see Baron and Diermeier (2007).

Following Cabral and Riordan (1994), we refer to these differences as *prizes*. A prize is the increment to the firm's long-run value due to a one-step increase in its reputation and thus represents the marginal benefit of reputation enhancement to the firm.

The Kuhn-Tucker conditions for the firm are:

$$MB_x \leq k; x \geq 0; (MB_x - k)x = 0, \quad (3)$$

where MB_x is the firm's marginal benefit of externality-reducing activity given by:

$$MB_x(x, \mathbf{V}_F^*(\mathbf{R}), \phi_A^*(R), \phi_\Delta^*(R)|R) \equiv \frac{\beta_F(1 - \phi_\Delta^*(R))\eta}{(1 + \eta x)^2} \left\{ \begin{array}{l} (1 - \phi_A^*(R)) [V_F^*(R+1) - V_F^*(R)] \\ + \phi_A^*(R) [V_F^*(R) - V_F^*(R-1)] \end{array} \right\}, \quad (4)$$

where $\mathbf{V}_F^*(\mathbf{R}) \equiv (V_F^*(1), \dots, V_F^*(\bar{R}))$.¹⁹

The marginal benefit function, which is strictly decreasing in x , is the firm's "demand curve" for externality reduction: it shows how much externality-reducing activity the firm "purchases" at "price" k . The activist shifts this demand curve both directly (through ϕ_Δ and ϕ_A) and indirectly, through the impact of the activist on $\mathbf{V}_F^*(\mathbf{R})$.

3.2 Activist's Bellman equation and Kuhn-Tucker conditions

Analogous to the Bellman equation for the firm, the Bellman equation for the activist gives us the present value of the activist's utility in state R in an equilibrium:

$$V_A(R) = \max_{z \geq 0, d \geq 0} \left\{ +\beta_A \left[\begin{array}{l} [1 - \phi_\Delta(d)] \left\{ \begin{array}{l} u(x^*(R)) - b_z z - b_d(R)d \\ \phi_F^*(R) [1 - \phi_A(z)] V_A^*(R+1) \\ + [1 - \phi_F^*(R) - \phi_A(z) + 2\phi_F^*(R)\phi_A(z)] V_A^*(R) \\ + [1 - \phi_F^*(x)] \phi_A(z) V_A^*(R-1) \end{array} \right\} \\ + \phi_\Delta(d) \frac{\sum_{r=1}^{\max\{R-1, 1\}} V_A^*(r)}{R-1} \end{array} \right] \right\}, \quad (5)$$

where $\beta_A \in (0, 1)$ is the activist's discount factor; $\phi_F^*(R) \equiv \phi_F(x^*(R))$, and (analogous to before) it is understood that in state $R = \bar{R}$, $V_A^*(R+1) = V_A^*(R)$ and in state $R = 1$, $V_A^*(R-1) = V_A^*(R)$.

The Kuhn-Tucker conditions are:

$$MB_z \leq b_z; z \geq 0; [MB_z - b_z]z = 0, \quad (6)$$

$$MB_d \leq b_d(R); d \geq 0; [MB_d - b_d(R)]d = 0, \quad (7)$$

¹⁹We condition on R in writing $MB_x(\cdot)$ because MB_x does not depend on the entire vector $\mathbf{V}_F^*(\mathbf{R})$ but rather on just parts of it in a manner specific to the state R .

where MB_z and MB_d are the marginal benefits of criticism and confrontation, respectively, and are given by:

$$MB_z(z, d, \mathbf{V}_A^*(\mathbf{R}), \phi_F^*(R)|R) = \frac{\beta_A(1 - \phi_\Delta(d))\alpha}{(1 + \alpha z)^2} \left\{ \begin{array}{l} \phi_F^*(R) [V_A^*(R) - V_A^*(R+1)] \\ + (1 - \phi_F^*) [V_A^*(R-1) - V_A^*(R)] \end{array} \right\}, \quad (8)$$

$$MB_d(d, z, \mathbf{V}_A^*(\mathbf{R}), \phi_F^*(R)|R) \equiv \frac{\beta_A\omega}{(1 + \omega d)^2} \left\{ \begin{array}{l} \sum_{r=1}^{R-1} \frac{1}{R-1} [V_A^*(r) - V_A^*(R)] \\ + \phi_F^*(R)(1 - \phi_A(z)) [V_A^*(R) - V_A^*(R+1)] \\ - (1 - \phi_F^*(R))\phi_A(z) [V_A^*(R-1) - V_A^*(R)] \end{array} \right\}. \quad (9)$$

Like MB_x , MB_z and MB_d depend on prizes that result from changes in the firm's reputation.

3.3 Equilibrium conditions

A MPE is a collection of five $(\bar{R} \times 1)$ vectors $(\mathbf{V}_F^*, \mathbf{V}_A^*, \mathbf{x}^*, \mathbf{z}^*, \mathbf{d}^*)$ satisfying the five sets of equilibrium conditions for each of the \bar{R} values of R : (2), (3), (5) (6), and (7).²⁰ The Kuhn-Tucker conditions are complementary slackness conditions, so for the the computational analysis below, it is useful to reformulate these conditions as a system of equations. To illustrate, consider (3). Following Borkovsky, Doraszelski, and Kryukov (2010), we can rewrite (3) as a pair of equations involving two variables, x and ζ_x

$$MB_x - k + [\max(0, \zeta_x)]^n = 0, \quad (10)$$

$$x + [\max(0, -\zeta_x)]^n = 0, \quad (11)$$

where $n \in \mathbb{N}$ is a large positive integer. The system (10) and (11) can be shown to be equivalent to (3) when

$$\zeta_x = \begin{cases} [MB_x - k]^{\frac{1}{n}} & \text{if } MB_x - k < 0, \\ -[x]^{\frac{1}{n}} & \text{if } x < 0, \\ 0 & \text{if } MB_x - k = x = 0. \end{cases} \quad (12)$$

Moreover, conditions (10) and (11) are $n - 1$ continuously differentiable with respect to x and ζ_x . Transforming the other Kuhn-Tucker conditions in this fashion, let $\mathbf{H}(\mathbf{V}_A, \mathbf{V}_F, \mathbf{x}, \mathbf{z}, \mathbf{d}|\Omega)$ denote the system of equations defining a MPE where Ω is a vector of parameters. A MPE $(\mathbf{V}_F^*, \mathbf{V}_A^*, \mathbf{x}^*, \mathbf{z}^*, \mathbf{d}^*, \zeta_x^*, \zeta_z^*, \zeta_d)$ thus solves

$$\mathbf{H}(\mathbf{V}_F^*, \mathbf{V}_A^*, \mathbf{x}^*, \mathbf{z}^*, \mathbf{d}^*, \zeta_x^*, \zeta_z^*, \zeta_d|\Omega) = 0, \quad (13)$$

²⁰Thus, for example, $\mathbf{V}_F^* = (V_F^*(1), \dots, V_F^*(\bar{R}))$, with the other terms in $(\mathbf{V}_F^*, \mathbf{V}_A^*, \mathbf{x}^*, \mathbf{z}^*, \mathbf{d}^*)$ defined in the same way.

Parameter	Description	Baseline value
R	Size of state space	30
R_0	Firm's initial reputation	15
c	Marginal cost of output	20
k	Marginal cost of externality-reducing investment, x	100
w_0	Intercept of marginal social benefit curve for x	125
w_1	Slope of marginal social benefit curve for x	0.5
ψ	Activist's passion	2
e_0	Brand equity for firm with $R = 1$	100
θ	Elasticity of brand equity with respect to reputation for citizenship	0.25
η	Salience parameter: externality-reducing activity	0.20
α	Saleince parameter: criticism	0.20
ω	Newsworthiness parameter: confrontation	0.20
b_z	Marginal cost of criticism (note: $b_d(R) = b_z \frac{R}{2}$)	150
β_F	Firm's discount factor	0.95
β_A	Activist's discount factor	0.95

Table 1: Baseline parameter values.

where $\mathbf{H}(\mathbf{V}_F^*, \mathbf{V}_A^*, \mathbf{x}^*, \mathbf{z}^*, \mathbf{d}^* | \Omega) = 0$ is a system of $8\bar{R}$ non-linear equations in $8\bar{R}$ unknowns.²¹ Condition (13) forms the basis of the computational analysis below.

4 Computational approach

Our objective is to develop comprehensive intuition about equilibrium interactions between a forward-looking firm and a forward-looking activist. To do this, we rely on a partial analytical characterization of the MPE, supplemented by computations of the MPE for a large set of parameter values. This section sets the stage for the computational analysis.

4.1 Baseline parameterization

Table 1 shows the baseline parameterization used to compute the “showcase” equilibrium. While the baseline parameterization is not intended to be representative of any particular industry, it is neither entirely unrepresentative nor extreme. To put these parameters in perspective, we note that the growth in the firm's reputation for corporate citizenship can potentially increase the firm's brand equity from $e = (15^{0.25})100 \approx 197$ at its initial value of $R = 15$ to $e = 100(30^{0.25}) \approx 234$, while brand equity could potentially fall to $e = 100$ if $R = 1$. Given the baseline demand and cost parameters, a crisis in the initial state that crashed the firm's reputation by the expected amount would cause its per-period profit contribution to fall by about 30 percent, while the worst possible crisis would cause per-period profit contribution to fall by about 80 percent. To put this in

²¹In addition to (2), (3), (5) (6), and (7), the other three equations are (12), and corresponding conditions for ζ_z and ζ_d .

perspective, when Extra Strength Tylenol was implicated in six deaths in suburban Chicago area in 1982, Tylenol’s sales dropped by about 87 percent (Lewin 1982). In our model, a shift in the demand curve sufficient to cause an 87 percent decline in sales revenue (given an optimal pricing response pre- and post-shift) would decrease the per-period profit contribution by about 98 percent. Thus, the worst possible crisis under our parameterization would be on a par with a Tylenol-style reputational crisis.²²

The discount factor can be thought of as $\beta_i = \frac{\zeta_i}{1+r}$, where $r > 0$ is the per-period discount rate and $\zeta_i \in (0, 1]$ is the exogenous probability that the agent survives from one period to the next. This interpretation is especially relevant for the activist, who may operate on a very tight budget, and who may suddenly disappear as a result of shocks to its funding. Consequently, our baseline parameterization corresponds to a variety of scenarios that differ in the length of a period. For example, it corresponds to a period length of one year, a yearly discount rate of 5.3 percent, and certain survival. But it also corresponds, for example, to a period length of one month, a monthly discount rate of 1 percent (which translates into a yearly discount rate of 12.68 percent), and a monthly survival probability of 0.96, which translates into an expected life span of about 26 months.

4.2 Computational analysis

We perform two types of computational analyses. First, to generate insight about possible regularities of the equilibrium, we compute equilibria over a grid \mathcal{G} of parameter values given by:

$$\mathcal{G} = \left\{ (\alpha, \omega, \psi, \theta, \beta_A) \mid \alpha \in \{0.10, 0.20, 0.30, 0.40\}, \omega \in \{0.10, 0.20, 0.30, 0.4\}, \psi \in \{0.5, 2.0, 4.0\}, \right. \\ \left. \beta_A \in \{0.80, 0.95, 0.99\}, \theta \in \{0.001, 0.15, 0.25, 0.35, 0.40\} \right\},$$

where in defining \mathcal{G} it is understood that all other parameters are fixed at baseline levels. The grid is designed to determine how the equilibrium varies as we vary all the parameters $(\alpha, \omega, \psi, \beta_A)$ that determine the activist’s incentives, as well as the parameter θ that determines the returns to the firm from corporate citizenship. The grid includes over 700 distinct parameterizations, including the baseline.

Second, we change key parameters on a one-at-a-time basis to isolate how each parameter affects the equilibrium. Any parameter not varied is set at its baseline level: The parameters varied are: (1) salience of criticism: $\alpha \in [0, 0.40]$; (2) newsworthiness: $\omega \in [0, 0.04]$; (3) activist’s discount factor: $\beta_A \in [0, 0.999]$; (4) firm’s discount factor $\beta_F \in [0, 0.999]$; (5) returns to corporate citizenship: $\theta \in [0, 0.40]$; activist passion: $\psi \in [0.5, 4]$. The method used for these computational exercises is described in the Appendix.

²²Of course, this effect would be transitory since, in equilibrium, the firm would then take steps to rebuild its reputation, as Johnson and Johnson did during the Tylenol crisis. Activist campaigns can have a similar (short-term) impact on sales. During Greenpeace’s 1995 campaign against Shell over the Brent Spar Platform Shell’s sales in Germany fell by 40 percent. For a discussion of both cases see Diermeier (2011), Chapters 1 and 3.

5 Results

5.1 Equilibrium behavior with no activist

To establish a benchmark, we describe the outcome when there is no activist. This corresponds to the case in which $\alpha = \omega = 0$.

Proposition 1 *In the absence of an activist, the firm's externality-reducing effort and value function $(x^*(R), V_F^*(R))$ are found by solving the following system of equations for (V_F, x) recursively:*

$$\begin{aligned} x^*(\bar{R}) &= 0 \\ V_F^*(\bar{R}) &= \frac{[e_0 \bar{R}^\theta - c]^2}{4(1 - \beta_F)}, \end{aligned}$$

and for $R < \bar{R}$

$$x = \max \left[\frac{1}{\eta} \left(\left\{ \frac{\beta_F \eta}{k} [V_F^*(R+1) - V_F] \right\}^{\frac{1}{2}} - 1 \right), 0 \right] \quad (14)$$

$$V_F = \frac{[e_0 R^\theta - c]^2}{4(1 - \beta_F)} + \frac{k\eta x^2}{(1 - \beta_F)}. \quad (15)$$

For any $R \in \{1, \dots, \bar{R} - 1\}$ the firm's value function is strictly increasing and strictly concave in R , i.e., $V_F^*(R+1) > V_F^*(R)$ and $V_F^*(R+1) - V_F^*(R) < V_F^*(R) - V_F^*(R-1)$. The firm's level of externality-reducing activity is non-increasing in R , i.e., $x^*(R+1) \leq x^*(R)$, and the inequality is strict in any state in which $x^*(R) > 0$.

Proposition 1 implies that in the absence of an activist, reputation enhancement is valuable to the firm, but it is subject to diminishing marginal returns. The firm thus reduces its externality-reducing activity as its reputation grows, i.e., it “coasts” on its reputation. Because Proposition 1 holds for an arbitrary end state, \bar{R} , which can be made arbitrarily large, the concavity of the value function is attributable to fundamentals (principally, the concavity of single-period profit in R), not to “end effects” due to a finite \bar{R} .

Figure 2 shows the equilibrium in the no activist case for the baseline parameter values. In this case, $x^*(R)$ (depicted in the middle panel) decreases monotonically from about 15 in the lowest state of $R = 1$ to 0 in $R = 30$. Given the assumed parameter values, this implies that there is a 0.58 probability of reputation growth in the initial state $R = 15$, but this declines over time as the firm's externality-reducing activity diminishes. This process of reputation growth can be shown to take about 40 periods on average. As the firm's reputation grows from $R = 15$ to $R = 30$, it is able to raise its price by about 17.5 percent (from about 108 to 127, as depicted in the right-hand panel), and its value grows by about 23 percent (from about 186,000 to 229,000, depicted in

the left-hand panel). Thus, as the firm’s reputation grows it coasts, and it eventually draws its externality-reducing activity down to zero.

5.2 Equilibrium behavior with an activist

5.2.1 The role and impact of the activist: a preliminary cut

The firm’s incentive to coast provides the basis for reputation-impairing action by the activist. If the firm did not coast (either globally or locally)—i.e., if $x^*(R)$ monotonically increased in R —the interests of the firm and the activist would be aligned. Both parties would benefit from a growth in the firm’s reputation, and the activist would have no reason to block the firm from increasing R . We show, though, that in equilibrium $x^*(R)$ cannot be monotonically increasing in R . Thus, even when the firm faces an activist, it still coasts on its reputation *to some extent*. This, in turn, provides a potential motivation for the activist to choose positive levels of either criticism or confrontation.

Proposition 2 *The firm’s equilibrium level of externality-reducing activity cannot be monotonically increasing in R ; i.e., there exists states R and $R + 1$ such that $x^*(R + 1) \leq x^*(R)$. Thus, the firm (weakly) “coasts” on its reputation in at least some states.*

The activist’s behavior has a potentially complex set of effects on the firm’s decision to invest in externality reduction. A useful starting point is to perform the following thought experiment. Start with a situation in which the activist’s criticism and confrontation are zero and then consider a small exogenous increase in confrontation d in a single focal state R_n . This generates an exogenous perturbation in the probability $\phi_\Delta^n = \phi_\Delta(d(R_n))$ of a crisis in the focal state, but keeps ϕ_Δ and ϕ_A fixed at zero in all other states. As the firm adjusts to this perturbation optimally, it will alter the profile of values, so $\mathbf{V}_F(\mathbf{R}) = \mathbf{V}_F(\mathbf{R}|\phi_\Delta^n) = (V_F(1|\phi_\Delta^n), \dots, V_F(\bar{R}|\phi_\Delta^n))$. This one-state perturbation, though far simpler than what actually happens in equilibrium, provides a relatively “clean” way to isolate how confrontation shifts the firm’s demand curve for externality-reducing activity at various points in the state space.

With ϕ_A held at zero, the marginal benefit of externality reduction in the focal state R_n becomes:

$$MB_x(x, \mathbf{V}_F(\mathbf{R}|\phi_\Delta^n), \phi_\Delta^n | R_n) = \frac{\beta_F \eta}{(1 + \eta x)^2} (1 - \phi_\Delta^n) [V_F(R_n + 1 | \phi_\Delta^n) - V_F(R_n | \phi_\Delta^n)],$$

and thus

$$\frac{dMB_x(x, \mathbf{V}_F(\mathbf{R}|\phi_\Delta^n), \phi_\Delta^n | R_n)}{d\phi_\Delta^n} = \frac{\beta_F \eta}{(1 + \eta x)^2} \left\{ \begin{array}{l} - [V_F(R_n + 1 | \phi_\Delta^n) - V_F(R_n | \phi_\Delta^n)] \\ + (1 - \phi_\Delta^n) \frac{\partial [V_F(R_n + 1 | \phi_\Delta^n) - V_F(R_n | \phi_\Delta^n)]}{\partial \phi_\Delta^n} \end{array} \right\}. \quad (16)$$

In all other states $R \neq R_n$ the marginal benefit of externality reduction is

$$MB_x(x, \mathbf{V}_F(\mathbf{R})|\phi_\Delta^n, \phi_\Delta^n|R) = \frac{\beta_F \eta}{(1 + \eta x)^2} [V_F(R + 1|\phi_\Delta^n) - V_F(R|\phi_\Delta^n)],$$

and thus

$$\frac{dMB_x(x, \mathbf{V}_F(\mathbf{R})|\phi_\Delta^n, \phi_\Delta^n|R)}{d\phi_\Delta^n} = \frac{\beta_F \eta}{(1 + \eta x)^2} \frac{\partial [V_F(R + 1|\phi_\Delta^n) - V_F(R|\phi_\Delta^n)]}{\partial \phi_\Delta^n}. \quad (17)$$

In the focal state R_n , the firm's demand curve depends on ϕ_Δ^n in two ways. First, an increase in ϕ_Δ^n directly decreases the marginal benefit of x in state R_n . Holding the prize $[V_F(R_n + 1|\phi_\Delta^n) - V_F(R_n|\phi_\Delta^n)]$ fixed, this effect would unambiguously shift the demand curve leftward in state R_n in a manner akin to the impact of *ad valorem* sales tax on a consumer demand curve. We call this the *direct effect* of confrontation on the firm's demand curve for externality reduction.²³ Note that there is *no* direct effect in states other than R_n .

Second, an increase in ϕ_Δ^n affects the prize itself, both in state R_n , as well in other states $R \neq R_n$. We call this the *prize effect* of confrontation, and it is given by the sign of $\frac{\partial [V_F(R+1|\phi_\Delta^n) - V_F(R|\phi_\Delta^n)]}{\partial \phi_\Delta^n}$, which is not obvious. We gain insight into it by performing a comparative statics analysis on ϕ_Δ^n , allowing ϕ_Δ^n to go to 0 (which places us at the no-activist equilibrium). The following Lemma characterizes the prize effect as the perturbation in confrontation goes to 0 in the limit.

Lemma 1 *Starting from the no-activist equilibrium, consider a one-state perturbation ϕ_Δ^n in the probability of a crisis in state $R_n < \bar{R}$: (a) In states $R \in \{R_n + 1, \dots, \bar{R}\}$, as $\phi_\Delta^n \rightarrow 0$, the prize effect for confrontation is zero, i.e., $\left. \frac{\partial [V_F(R+1|\phi_\Delta^n) - V_F(R|\phi_\Delta^n)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = 0$; (b) In the focal state R_n , as $\phi_\Delta^n \rightarrow 0$, the prize effect is strictly positive and is given by*

$$\left. \frac{\partial [V_F(R_n + 1|\phi_\Delta^n) - V_F(R_n|\phi_\Delta^n)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = \frac{\beta_F}{1 - \beta_F} \left[V_{F0}^*(R_n) - \frac{\sum_{r=1}^{R_n-1} V_{F0}^*(r)}{R_n - 1} \right],$$

where the notation $x_0^*(\cdot)$ and $V_{F0}^*(\cdot)$ refers to the equilibrium policy and value functions in the no-activist equilibrium; (c) in states $R \in \{1, \dots, R_n - 1\}$, as $\phi_\Delta^n \rightarrow 0$, the prize effect is strictly positive.

Lemma 1, in conjunction with (16) and (17), lead immediately to:

Proposition 3 *Starting from the no-activist equilibrium, consider a one-state perturbation ϕ_Δ^n in the probability of a crisis in state $R_n < \bar{R}$. As $\phi_\Delta^n \rightarrow 0$, the impact of the perturbation on the firm's externality-reducing activity is as follows: (a) In states $R > R_n$, the perturbation has no effect; (b) In the focal state $R = R_n$, the perturbation has an ambiguous effect (a negative direct effect may or may not be offset by a positive prize effect); (c) In states $R < R_n$, the perturbation has a positive effect (due to the positive prize effect).*

²³The direct effect is analogous to the compensated effect of price on quantity demanded in consumer theory.

However, if the perturbation is “large,” the direct effect must dominate the prize effect in the focal state.

Proposition 4 *Starting from the no-activist equilibrium, consider a one-state perturbation ϕ_Δ^n in the probability of a crisis in state $R_n < \bar{R}$, and suppose that in this state, the firm would have invested a positive amount in externality-reducing activity. As $\phi_\Delta^n \rightarrow 1$, the direct effect in state R_n dominates the prize effect and has an unambiguously negative effect on the firm’s externality-reducing activity in state R_n .*

Propositions 3 and 4 hint at the complexity of the activist’s role in shaping the firm’s behavior. In equilibrium, “single-state perturbations” occur in *all* states simultaneously, and none of these “perturbations” are necessarily “small” or “large.” Moreover, they interact with perturbations in criticism z , which was fixed in our thought experiment. Moreover, in equilibrium the “perturbations” are themselves endogenous, so the firm’s equilibrium decisions feed back and effect them. Finally, both the direct and prize effects are static phenomenon in the sense that they relate to the impact of the activist on the intensity of the firm’s incentives in particular states. They do not speak to how the presence of the activist will change the dynamics of how the firm’s reputation evolves over time.

Still, this analysis, limited though it is, provides a helpful insight: the activist’s impact on the firm’s externality-reducing activity is not unambiguously positive. That is, the presence of an activist may have (for the activist) the unintended consequence (through the direct effect of confrontation) of suppressing the thing that the activist wants, namely an abundant supply of x .

We can also conduct an analysis of a small perturbation in criticism, yielding to a positive probability ϕ_A^n in focal state R_n . With ϕ_Δ held to 0, the expression for marginal benefit (4) in the focal state is:

$$MB_x(x, \mathbf{V}_F(\mathbf{R})|\phi_A^n, \phi_A^n|R) = \frac{\beta_F \eta}{(1 + \eta x)^2} \left[\begin{array}{c} V_F(R+1|\phi_A^n) - V_F(R|\phi_A^n) \\ + \phi_A^n \left\{ \begin{array}{c} [V_F(R|\phi_A^n) - V_F(R-1|\phi_A^n)] \\ - [V_F(R+1|\phi_A^n) - V_F(R)|\phi_A^n] \end{array} \right\} \end{array} \right].$$

The direct effect of ϕ_A^n is given by the term $\left\{ \begin{array}{c} [V_F(R|\phi_A^n) - V_F(R-1|\phi_A^n)] \\ - [V_F(R+1|\phi_A^n) - V_F(R)|\phi_A^n] \end{array} \right\}$, which depends on the concavity of the firm’s value function. Our computations reveal that the firm’s equilibrium value function is not necessarily concave when an activist is present. However, as $\phi_A^n \rightarrow 0$,

$$\left\{ \begin{array}{c} [V_F(R|\phi_A^n) - V_F(R-1|\phi_A^n)] \\ - [V_F(R+1|\phi_A^n) - V_F(R)|\phi_A^n] \end{array} \right\} \rightarrow \left\{ \begin{array}{c} [V_{F_0}^*(R) - V_{F_0}^*(R-1)] \\ - [V_{F_0}^*(R+1) - V_{F_0}^*(R)] \end{array} \right\},$$

and Proposition 1 established that this latter expression is non-negative. This gives us the following result:

Proposition 5 *In the focal state R_n , the direct effect of criticism for small perturbations is non-negative.*

Proposition 5 highlights that criticism and confrontation can have different effects on the firm’s marginal benefit of externality reduction. The proposition, to be sure, provides only limited insight (e.g., it says nothing about the prize effect of criticism, or the direct effect for “non-small” changes, both of which appear to be generally ambiguous). But like Propositions 3 and 4, it hints at the complex impact that the activist can have on the firm’s equilibrium behavior.

Figure 3 summarizes the implications of the preceding propositions. Confrontation in a given state may shift the firm’s demand curve leftward or rightward, depending on the strength of the direct and prize effects. Confrontation in higher states unambiguously shifts the demand curve in a given state leftward due to the prize effect. Small levels of criticism in a given state has a direct effect of shifting the firm’s demand curve rightward in a given state, but an ambiguous prize effect. What happens in equilibrium is a complex amalgam of these various shifts.

5.2.2 Computational results: baseline parameterization

Figure 4 shows the value functions (upper panel) and policy functions (lower panel) for this showcase equilibrium.²⁴ The equilibrium level of externality-reducing activity, $x^*(R)$, generally decreases as the firm’s reputation grows, but not everywhere. Thus, there is coasting, but the coasting is not global.

A comparison of Figures 2 and 4 indicates that in any state R , the firm’s externality-reducing activity is less when there is an activist than when there is not, i.e., $x^*(R) < x_0^*(R)$. The direct effect of confrontation, discussed above, is one driver of this, though it may not be the only one.

However, even though the activist induces a reduction in the intensity of externality reduction state-by-state, it does not follow that over time the firm will invest less when there is an activist. This is because, as can be seen in the lower panel of Figure 4, the activist generally engages in positive amounts of both criticism and confrontation, with the mix of the two activities varying with R . Therefore, unlike the no-activist case, the firm will, in all likelihood, not reach states in which its externality-reducing activity falls to 0.

To expand on this point, it is useful to describe the dynamics of the model. The equilibrium actions of the firm and activist generate a Markov process. Given any starting state, this process implies a transient probability distribution over R , $x^*(R)$, $z^*(R)$ and $d^*(R)$ for any time period t . Using these distributions, we can construct expectations over the firm and the activist’s equilibrium behavior, as well as the firm and activist’s value, for any time $T = t$. Figure 5 illustrates the path of these expectations assuming $R_0 = 15$. The upper panels show how the firm’s expected reputation and externality-reducing effort vary over time. For example, by $T = 20$, the firm’s expected reputation $\mathbb{E}_{20}[R]$ is approximately equal to 11, and as time passes, reputation is expected to fall to

²⁴Though we cannot rule out the possibility of multiple equilibria, we were unable to find more than one equilibrium in this case.

slightly less than 10. Due the activist’s efforts to impair the firm’s reputation, the firm experiences a gradual decline in reputation from the initial state.²⁵ However, unlike the no-activist case, the firm does not, in the long run, stop investing in externality reduction. Indeed, there is sharp contrast in the time path of the firm’s externality-reducing activity without and with an activist. Without an activist, the time path of externality reduction declines over time; with an activist, the firm’s expected externality-reducing activity would actually rise over time, settling into an expected level of a little over 7 in the long run.

But this expectation actually disguises the fluidity of the firm’s situation. As time passes both the firm and the activist continue to invest, which causes small increases and decreases in the firm’s reputation, as well as an occasional crisis which causes reputation to fall dramatically. Figure 6 shows the transient distributions over the firm’s reputation at three points in time: $T = 4, 8,$ and 16. It also shows the limiting distribution over R , which we use to characterize the long-run dynamics of the game. In the long run, the firm’s reputation could range from 1 to 30, with (as indicated earlier) an expectation a little less than 10 and a mode of about 2. Thus, the interaction between the firm and the activist gives rise to a dynamic in which the firm occasionally manages to increase its reputation, but because $x^*(R)$ decreases in R throughout most of the state space, each time it increases its reputation, it reduces its externality-reducing activity. From time to time, the activist’s criticism reduces the firm’s reputation, and sometimes, the activist provokes a severe crisis that causes the firm’s reputation to collapse drastically. In the aftermath of these episodes, the firm’s motivation to enhance its reputation increases and it steps up its externality-reducing activity.

5.2.3 Computational results: grid search over \mathcal{G}

The baseline parameters represent a single point in parameter space. To explore the generalizability of the insights generated by this example, we turn to the grid search over \mathcal{G} .

We begin by summarizing the extent to which equilibria have certain properties in common. Table 2 reports percentages of the parameterizations for which various properties were true in particular states, while Table 3 reports the percentage of parameterizations in which the equilibrium had particular dynamic properties.²⁶

From these tables we can draw a number of conclusions. The first property in Table 2 compares the firm’s equilibrium level of externality-reducing activity in a given state R to the level that would have prevailed in the absence of an activist:

²⁵Of course, these dynamics are contingent on the starting state. If the starting state had been less than $R = 10$, there would have been a gradual rise in the firm’s reputation to about 10.

²⁶At all points in \mathcal{G} , we did not identify cases of multiple MPE.

		Proportion of equilibria in \mathcal{G} with property in state R														
Properties		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
1. $x^*(R) \leq x_0^*(R)$		0.96	0.91	0.91	0.89	0.87	0.89	0.90	0.91	0.89	0.92	0.88	0.92	0.87	0.89	0.89
2. $x^*(R) \leq x^*(R+1)$		0.64	0.62	0.43	0.35	0.33	0.33	0.32	0.32	0.32	0.32	0.32	0.32	0.31	0.32	0.31
3. $x^*(R) < x^*(\frac{R}{2})$ or $x^*(\frac{R-1}{2})$.	0.36	0.37	0.47	0.53	0.64	0.66	0.67	0.68	0.68	0.68	0.69	0.69	0.69	0.69
4. $V_F^*(R) \leq V_{F_0}^*(R)$		0.72	0.72	0.71	0.70	0.70	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
5. $V_A^*(R) \geq V_{A_0}^*(R)$		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6. $V_F^*(R+1) \geq V_F^*(R)$		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7. $V_A^*(R) \geq V_A^*(R+1)$		0.88	0.88	0.85	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Properties		Proportion of equilibria in \mathcal{G} with property in state R														
Properties		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1. $x^*(R) \leq x_0^*(R)$		0.89	0.89	0.88	0.86	0.84	0.85	0.88	0.86	0.86	0.84	0.82	0.81	0.78	0.63	0.80
2. $x^*(R) \leq x^*(R+1)$		0.32	0.31	0.32	0.31	0.31	0.31	0.32	0.31	0.32	0.31	0.32	0.31	0.54	0.31	.
3. $x^*(R) < x^*(\frac{R}{2})$ or $x^*(\frac{R-1}{2})$		0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
4. $V_F^*(R) \leq V_{F_0}^*(R)$		0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67
5. $V_A^*(R) \geq V_{A_0}^*(R)$		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6. $V_F^*(R+1) \geq V_F^*(R)$		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.
7. $V_A^*(R) \geq V_A^*(R+1)$		0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	.

Table 2: Properties of equilibria, state-by-state, in the parameter grid.

Property	Proportion of equilibria in \mathcal{G}
$\mathbb{E}_\infty[R] < \bar{R} = 30$	0.953
$\mathbb{E}_\infty[R] < 20$	0.680
$\mathbb{E}_\infty[R] < 10$	0.302
$Mode_\infty[R] < 30$	0.684
$Mode_\infty[R] < 20$	0.665
$Mode_\infty[R] < 10$	0.338

Table 3: Expected and modal long-run states for equilibria in the parameter grid

Result 1 *For each state $R \in \mathcal{R}$, $x^*(R) \leq x_0^*(R)$ for over 60 percent of the equilibria in the grid, and in 27 of 30 states, $x^*(R) \leq x_0^*(R)$ for over 80 percent of the equilibria in the grid. Thus, the presence of the activist often reduces the firm’s externality-reducing activity in a given state.*

We also see that, Proposition 2 notwithstanding, Proposition 1 does not extend to the equilibrium with an activist:

Proposition 6 *In contrast to the equilibrium in the absence of an activist, the firm’s equilibrium level of externality-reducing activity is not monotonically decreasing in R ; i.e., there exists states R and $R + 1$ such that $x^*(R + 1) > x^*(R)$. Thus, the firm does not globally coast on its reputation.*

On the other hand, coasting does occur to some extent, and it ensures that in the wake of a crisis of expected severity, a firm may often increase its level of externality-reducing activity:

Result 2 *For each state $R \geq 8$, $x^*(R) < x^*(\frac{R}{2})$ or $x^*(\frac{R-1}{2})$ for over two-thirds of the equilibria in the grid. Thus, for a firm with a sufficiently strong reputation, a crisis that reduces the firm’s reputation to the expected post-crisis level will tend to motivate the firm to increase its externality-reducing activity.*

We also see from Table 2 that while the firm benefits from enhancing its reputation, the activist’s value often declines when R increases.

Result 3 *The firm’s value function is increasing in R . By contrast, the activist’s value function usually —though not always—is decreasing in R . Thus, the firm benefits from an improvement in its reputation, while the activist often benefits by hurting the firm’s reputation.*

Table 3 provides insight into the nature of the dynamics in the model and shows that in contrast to the no-activist case, the firm’s reputation would rarely be expected to grow to the maximal attainable level:

Result 4 *The firm rarely (in fewer than 5 percent of computed equilibria) would be expected to attain the maximum possible reputation state R in the long run, and often (more than 2 out of 3 cases) would be expected to attain a long-run reputational state less than $R = 20$.*

Equilibrium type	Proportion of cases in \mathcal{G}	Representative parameterization
Diversified activist	0.100	baseline parameterization
Specialized activist: confrontation	0.080	ω large relative to α
Specialized activist: criticism	0.030	α large relative to ω
Ineffective activist	0.478	low value of $\theta, \psi, \beta_A, \alpha$ and/or ω
Not classifiable	0.312	

Table 4: Taxonomy of equilibria

Equilibrium type	$\mathbb{E}_4[x^*(R)]$	$\mathbb{E}_\infty[x^*(R)]$
Diversified activist	12.89	13.34
Specialized activist: confrontation	11.50	11.47
Specialized activist: criticism	12.17	4.01
Ineffective activist	3.23	0

Table 5: Average level of short-run and long-run externality-reducing investment by type of equilibrium.

We next classify equilibria into three categories: (1) Diversified activist; (2) Specialized activist; (3) Ineffective activist. A diversified activist engages in positive amounts of criticism and confrontation for *long-run relevant* values of R , where “long-run relevant” means that the probability of that state in the limiting distribution is at least 0.10.²⁷ A specialized activist engages in just criticism or just confrontation in the long-run relevant states. An ineffective activist does not engage in either activity in the long-run relevant states. Table 4 characterizes the equilibria according to this taxonomy, while Table 5 shows how type of equilibrium correlates with short-run and long-run levels of externality-reducing activity (measured by the average values of $\mathbb{E}_4[x^*(R)]$ and $\mathbb{E}_\infty[x^*(R)]$ over each equilibrium in the category).

About 48 percent of the equilibria in the grid involve ineffective activists. This is because for particularly low values of θ (like $\theta = 0.001$), the firm does not invest in externality reduction because a reputation for corporate citizenship has very limited value, so, in turn, there is limited benefit to activities aimed at compromising the firm’s reputation. Ironically, then, firms that are apathetic to building a reputation are not inviting targets for activists. Table 5 indicates that externality-reducing activity is generally highest in both the short and long run when there is a diversified activist and generally the lowest when there is an activist that specializes in criticism. We summarize these results as follows:

Result 5 *Diversified activists generally induce the firm to choose the highest levels of externality-reducing activity in both the short run and the long run.*

Results 1-5 provide a strong suggestion of the forces at work in the model and the trade-offs they create. On the one hand, positive levels of criticism and confrontation change the firm’s incentives for externality-reducing activity in a given state through the direct and prize effects. In particular,

²⁷We also used a cutoff of 0.05 to define long-run relevant states. The lower cutoff results in more non-classifiable equilibria, but the breakdown between diversified, specialized, and ineffective activists was about the same.

the tendency for $x^*(R)$ to be less than $x_0^*(R)$ in a given state R (identified in Result 1) is a footprint of the negative direct effect of confrontation. On the other hand, the activist's presence changes the evolution of states in the game. The clearest manifestation of this is Result 2, which indicates that in the wake of a crisis the firm would, more often than not, step up its level of externality-reducing activity. The activist thus provides an antidote to coasting: its actions shape the dynamics of the game in a way that tends to keep the firm in states in which it is more motivated to invest in x .

In the introduction we raised the question of why firms with well-established brands (e.g., Coca Cola) seem to devote significant resources to voluntary efforts that address negative externalities or other social problems, even when it is hard to imagine how such activity could make their very strong brands even stronger. Or, put differently, why don't firms with strong reputations seem to reach a point of diminishing returns that makes it worthwhile to coast on their reputations? Our model resolves this puzzle by highlighting the role of activists and the damage they can do to corporate reputations. In particular, the activist tends to keep a targeted firm's reputational capital at levels at which the accumulation of additional reputational capital has significant value. For this to occur, the activist must use confrontation and criticism as more than just threats; there must be a positive probability along the equilibrium path that the activist actually harms the firm's reputation from time to time.²⁸

5.3 Comparative statics of long-run outcomes

An equilibrium is a vector in a large multi-dimensional space, so describing in a compact way how it changes with changes in underlying parameters is difficult. To simplify this task, we focus on how changes in parameters affect the long-run equilibrium behavior, summarized by $\mathbb{E}_\infty [x^*(R)]$, $\mathbb{E}_\infty [z^*(R)]$, and $\mathbb{E}_\infty [d^*(R)]$; long-run performance, summarized by $\mathbb{E}_\infty [R]$ and $\mathbb{E}_\infty [p^*(R)] = \mathbb{E}_\infty \left[\frac{e_0 R^\theta + c}{2} \right]$; and long-run value, summarized by $\mathbb{E}_\infty [V_F^*(R)]$ and $\mathbb{E}_\infty [V_A^*(R)]$.

5.3.1 Activist efficacy: variations in α and ω

Figures 7 and 8 summarize how expected long-run equilibrium outcomes change as we vary the saliency parameter α , holding all other parameters fixed at baseline levels. (The dotted line identifies the baseline value of the focal parameter, in this case α .)²⁹ Figure 7 illustrates that as α increases, the activist tends to engage in more criticism and less confrontation in the long run.

²⁸This effect could also operate if a firm faced an exogenous probability of either a reputational crisis or a marginal diminution of its reputation. Thus, activists *per se* are not critical to resolving the puzzle set out in the introduction. Still, the forces that enable activists to harm corporate reputations, such as the nature of the mass media environment, are much the same forces that allow exogenous events, such as an oil spill or a major product defect, to become newsworthy enough to impair a company's reputation. Moreover, activists are often quick to exploit such exogenous events. The key point is that our theory suggests that whether activist-induced or exogenous, periodic destruction of reputational capital can keep a firm sufficiently motivated to enhance it, thereby explaining why some companies never seem to reach the point at which it makes sense to coast.

²⁹For each comparative statics analysis in this section, we present two figures. The first shows how long-run equilibrium behavior (x, z, d) varies with the focal parameter, and the second shows how long-run performance (reputation, price, and firm and activists values) vary with the focal parameter.

This suggests that the activist’s policy tools are substitutes. If the activist’s criticism has salience just a little below the baseline level (which, recall, is where $\alpha = \omega$), then in the long run it stops relying on this instrument and specializes in fomenting crises. Thus, z and d appear to be imperfect but close substitutes.

Figure 8 illustrates that an increase in salience has an ambiguous impact on the firm’s long-run reputation and its value. Initially, long-run reputation and value rises with an increase in α . This is because the increase in criticism induces a substitution away from confrontation, which reduces the probability of crises, limiting the frequency with which the firm’s reputation crashes. However, as salience increases even more, the firm’s expected long-run reputation and value fall. This is associated with an increase in the level of the firm’s externality-reducing activity.

Figures 9 and 10 summarize the impact on the equilibrium of changes in the newsworthiness parameter ω . This analysis reinforces the insight that criticism and confrontation are imperfect but close substitutes. If ω increases just a little above the baseline level, $\mathbb{E}_\infty[z^*(R)]$ falls to 0, while if ω increases just a little below the baseline level, $\mathbb{E}_\infty[d^*(R)]$ falls to 0. An empirical implication is that if otherwise similarly situated activists have different α ’s or ω ’s due to idiosyncratic reasons, we would expect to see the activists specialize in one tactic or the other.

Changes in ω have an ambiguous effect on the firm’s long-run externality-reducing activity, and that effect differs from the effect of changes in α . If the newsworthiness parameter increases beyond a certain point, the long-run level of x declines. This reflects a sufficiently powerful direct effect of confrontation discussed earlier.

$\mathbb{E}_\infty[d^*(R)]$ is also non-monotonic in ω ; as it becomes sufficiently easy to provoke a crisis, the activist’s expected confrontation is scaled back in equilibrium.

Finally, the activist’s long-run value $\mathbb{E}_\infty[V_A^*(R)]$ may decrease in ω . This is a consequence of the decline in $\mathbb{E}_\infty[x^*(R)]$ for sufficiently large values of ω . If provocative activity is highly newsworthy, the activist is actually hurt. The logic is that in a media environment in which crises are very easy to provoke, a firm simply gives up hope that it can sustain a good reputation for corporate citizenship and scales back the externality-reducing activity that the activist values. We can summarize the results of this analysis as follows:

Result 6 (i) *For the activist, criticism and confrontation are imperfect substitutes; (ii) Increasing the newsworthiness of the activist’s efforts to provoke a crisis does not unambiguously increase the firm’s long-run externality-reducing activity, nor does it necessarily increase the intensity of the activist’s confrontation in the long run; (iii) By contrast, increasing the saliency of the activist’s criticisms of the firm does increase the firm’s long-run externality-reducing activity (over the range where the activist engages in positive amounts of criticism).*

5.3.2 Activist and firm patience: variations in β_A and β_F

Figures 11 and 12 summarize the impact on long-run equilibrium outcomes of varying β_A , holding all other parameters fixed at baseline levels. A moderately impatient activist (β_A between about 0.60 and 0.90) is a minor threat to the firm; it engages in small amounts of criticism, but no confrontation in the long run. A highly impatient activist (β_A less than about 0.60) is no threat at all; it engages in no equilibrium activity of any kind. The most dangerous activist, from the firm's perspective, is a patient one. As β_A increases, the activist aggressively substitutes confrontation for criticism (except for the very highest values β_A , at which point the activist increases both activities in tandem).³⁰

Recall that the discount factor reflects both the time preference of the activist, as well as its survival probability. The computational results indicate that a well-funded activist with strong survival prospects is more likely to attempt to provoke a crisis, while an activist with a lower survival probability will tend to engage in criticism. This is not because confrontation is less expensive or more efficacious for the well-funded activist (efficacy and cost are being held fixed in this analysis), but rather because the payoff from the activist's two instruments have different dynamic implications. Inducing a crisis that crashes the firm's reputation has a potentially big payoff to the activist since the firm, in the wake of the crisis, significantly increases x to rebuild its image. However, it takes time for the activist to engineer a crisis of sufficient impact to really matter, so a less well-funded, and therefore more impatient, activist may forego crisis provocation altogether and instead seek to motivate the firm by activities that marginally chip away at its reputation. We summarize these insights as follows:

Result 7 *A more patient activist tends to rely on confrontation to a greater degree, and on criticism to a lesser degree, than a less patient activist. Above a threshold value of β_A , the firm's value declines precipitously as β_A increases.*

Figures 13 and 14 summarize the impact on long-run equilibrium outcomes by varying β_F , holding all other parameters (including β_A) fixed at baseline levels. There are two noteworthy implications of this analysis. First, a more patient firm is more vulnerable to a crisis than a less patient firm. Second, an activist prefers to interact with a more patient firm. These implications arise because a more patient firm derives a bigger prize from building reputation than a less patient firm, which makes the more patient firm more willing to invest in reputation-building. This directly benefits the activist. When a crisis occurs, the more patient firm has a greater motivation to rebuild its reputation than the less patient firm, which makes crisis provocation a particularly attractive strategy against a patient firm. This latter implication suggests that if the activist must choose among potential targets, a financially sound firm would be a more attractive target than a marginal firm. This is consistent with empirical evidence about activist behavior (Easley and Lenox, 2006). We summarize the insights from this part of the analysis as follows:

³⁰Thus, for extremely patient activists, reputation-impairing and crisis-inducing effort become complementary.

Result 8 *A more patient firm is more susceptible to crises than a less patient firm. The activist prefers a more patient target to a less patient target.*

5.3.3 Returns to reputation for corporate citizenship: variations in θ

Figures 15 and 16 summarize the impact on long-run equilibrium outcomes by varying θ , holding all other parameters fixed at baseline levels. The greater the impact of reputation on brand equity, the more the firm invests in externality-reducing activity. However, the activist's behavior is not monotonic in θ . For $\theta \leq 0.125$, the firm does not invest in externality reduction, and the activist accordingly chooses no activity of either kind. Once θ exceeds 0.125, there is an upward jump in criticism, but as θ increases between 0.125 and 0.25, the activist decreases criticism and substitutes confrontation for it. As θ increases further above 0.25, increases in θ elicit more of both types of activities. Criticism is apparently the more attractive tool for the activist when it faces a firm that has only a modest concern with using corporate citizenship to build brand equity. By contrast, when corporate citizenship has a large effect on brand equity, crisis provocation becomes increasingly attractive. Thus, a firm for whom an image of good corporate citizenship is particularly important would be especially vulnerable to confrontational tactics by an activist.³¹ We summarize this part of the analysis as follows:

Result 9 *If θ is below a threshold level, the firm does not engage in externality-reducing activity in the long run, and the activist does not engage in any effort to harm the firm's reputation. Above that threshold, as θ increases, the firm's long-run externality-reducing activity increases, as does the activist's levels of confrontation, increasing the likelihood of crises. The activist's long-run level of criticism initially falls as θ increases above the threshold, but it eventually begins to increase.*

5.3.4 Activist passion: variations in ψ

Figures 17 and 18 summarize how variations in the activist's passion affect long-run equilibrium behavior and performance. If ψ is slightly less than 1, it is completely ineffective: it engages in no criticism or confrontation. If the activist's objective function is social welfare ($\psi = 1$, indicated by the dotted line in the left of each panel), it engages in positive, but very small, amounts of criticism and confrontation. Thus, an activist that sees itself merely acting on behalf of the general public interest will hardly make a difference in the long run. Only if the activist is sufficiently passionate will it be motivated to take actions that lead to significant amounts of externality-reducing activity in the long run. However, beyond a certain point (ψ slightly less than 2) increases in ψ induce a decline in externality-reducing activity. This is because the passionate activist is very keen to provoke a crisis (long-run confrontation monotonically increases in ψ). However, because of the direct effect of confrontation this will induce the firm to scale back its externality-reducing activity.

³¹For empirical evidence supporting this claim see, e.g. Eesley and Lenox (2009).

Property	Proportion of equilibria in \mathcal{G}
$\mathbb{E}_\infty[x^*(R)] > \mathbb{E}_\infty[x_0^*(R)] = 0$	0.518
$Mode_\infty[x^*(R)] > Mode_\infty[x_0^*(R)] = 0$	0.424
$\mathbb{E}_\infty[x^*(R)] < x^F$	1.00
$Mode_\infty[x^*(R)] < x^F$	1.00

Table 6: Proportion of equilibria in the parameter grid for which the firm’s long-run investment in externality reduction is positive and/or less than the first best level

Increasing the passion of the activist makes the activist a more dangerous adversary for the firm, but may not advance the social interest. We summarize this analysis as follows:

Result 10 *If the activist is insufficiently passionate, it engages in no crisis or confrontation of any kind and is thus ineffective. As the activist’s passion increases beyond this threshold, the long-run level of confrontation rises monotonically, while the long-run level of criticism initially decreases but then increases in ψ . The firm’s long-run externality-reducing activity increases as the activist’s passion increases beyond the threshold, but eventually it falls. The firm’s long-run value monotonically decreases as activist passion increases.*

6 Welfare implications

Do activists have social value? We address that question in our model by focusing on the impact of activist on the net social benefit of the firm’s externality-reducing effort, which is given by $w(x) - kx$.³² The net social benefit is maximized by the first-best level of externality reducing activity, $x^F = \frac{w_0 - k}{w_1}$. For the baseline parametrization, $x^F = 50$, which yields a per-period net social benefit of 625.

Let us first consider the long-run impact of the activist. Recall that without an activist, the long-run level of externality reduction is zero. By contrast, as Table 6 indicates, $\mathbb{E}_\infty[x^*(R)] > 0$ for about 52 percent of parameterizations in \mathcal{G} , and $Mode_\infty[x^*(R)] > 0$ in about 42 percent of the parameterizations.³³ Thus, the presence of the activist often ensures positive levels of long-run externality reduction. Note, too, that the activist does not motivate excessive levels of externality reduction. Table 6 indicates that in all parameterizations $\mathbb{E}_\infty[x^*(R)] < x^F$ and $Mode_\infty[x^*(R)] < x^F$, i.e., expected and modal long-run externality-reducing activity is less than the first-best level.

Table 7 shows the long-run welfare effects directly by reporting the expected per-period net social benefit $w^\infty \equiv \mathbb{E}_\infty[w(x^*(R)) - kx^*(R)]$ for various parameterizations.³⁵ The presence of

³²One might wonder why we do not include in our analysis the welfare impact of the activist in the firm’s product market. Because we have not explicitly modeled consumer demand behavior (and, more precisely, the process by which brand equity translates into higher consumer demand), we do not have a compelling way to specify how consumer welfare is affected by reputation R . Hence, we focus on the net social benefit of externality reduction.

³³ $\mathbb{E}_\infty[x^*(R)]$ tends to be zero for those parametrizations that yield ineffective activists.

³⁵The figure reported in each cell of Table 7 is the average net social benefit across the equilibria corresponding to a particular set of parameterizations. Thus, for example, the average long-run net social benefit for the subset of parameterizations in \mathcal{G} yielding confrontational activists is 88.95.

	Long-run net social benefit	
	No activist (w_0^∞)	Activist (w^∞)
Baseline parameterization	0	171.01
All parameterizations in \mathcal{G}	0	88.95
Parameterizations yielding confrontational activists	0	100.99
Parameterizations yielding critical activists	0	83.85
Parameterizations yielding diversified activists	0	123.88
Lower-passion activist	0	54.01
Higher-passion activist ³⁴	0	83.82

Table 7: Long-run net social benefit from externality-reducing activity

	Discounted net social benefit: $\beta_S = 0.95$	
	No activist (W_0^{NPV})	Activist (W^{NPV})
Baseline parametrization	2,194	2,858
All parameterizations in \mathcal{G}	1,879	2,270
Parameterizations yielding confrontational activists	1,446	1,986
Parameterizations yielding critical activists	2,438	3,610
Parameterizations yielding diversified activists	1,545	2,281
Lower-passion activist	2,019	2,398
Higher-passion activist	1,357	1,489

Table 8: Discounted net social benefit from externality-reducing activity: $\beta_S = 0.95$

the activist improves long-run welfare relative to the no-activist case, though the improvement falls short of attaining the first-best per-period welfare level. The improvement in net social benefit relative to the no-activist case tends to be greatest for those parameterizations that result in diversified activists. Notice that in the long-run, high-passion activists result in a higher level of per-period welfare than low-passion activists. We summarize these results as follows:

Result 11 *The presence of an activist enhances long-run social welfare relative to what it would have been in the absence of an activist. Long-run expected welfare tends to be highest with diversified activists, and lowest with lower-passion activists.*

An alternative way to evaluate the impact of the activist is to compare the discounted net social benefit with and without the activist over the horizon of the game; i.e., $W^{NPV} = \lim_{T \rightarrow \infty} \sum_{t=0}^T \beta_S^t \mathbb{E}_t[w(x^*(R)) - kx^*(R)]$ and $W_0^{NPV} = \lim_{T \rightarrow \infty} \sum_{t=0}^T \beta_S^t \mathbb{E}_t[w(x_0^*(R)) - kx_0^*(R)]$, where β_S is the social discount factor. W^{NPV} reflects the trade-off between the short-run and long-run impact of the activist. Even though the absence of an activist results in zero expected welfare in the long run, it will generally result in a positive discounted net social benefit because $x_0^*(R) > 0$ for $R < \bar{R}$. Thus, the comparison between the no-activist and activist cases reflects a trade-off between the tendency of the activist to boost long-run externality reduction due to its impact on the evolution of the game and its tendency to decrease the firm's externality-reducing activity on a state-by-state basis.

Table 8 presents the comparisons of discounted social welfare when $\beta_S = 0.95$.³⁶ For all the

³⁶Recall that this is the firm's and activist's discount factor in the baseline parameterization. As in all the calculations

	Discounted net social benefit: $\beta_S = 0.99$	
	No activist (W_0^{NPV})	Activist (W^{NPV})
Baseline parametrization	3,372	7,588
All parameterizations in \mathcal{G}	2,791	5,187
Parameterizations yielding confrontational activists	2,055	4,936
Parameterizations yielding critical activists	3,677	7,615
Parameterizations yielding diversified activists	2,201	5,842
Lower-passion activist	2,981	4,716
Higher-passion activist	2,085	3,890

Table 9: Discounted net social benefit from externality-reducing activity: $\beta_S = 0.99$

parameterizations in \mathcal{G} , the presence of the activist, on average, increases expected discounted net benefit by about 20.82 percent (from 1,879 to 2,270). The highest level of discounted social welfare is achieved for those parameterizations that yield critical activists. In these cases, the negative direct effect of confrontation is weaker than it is with confrontational or diversified activists. Of all parameterizations, the one with a higher-passion activist yields the smallest gain from having an activist, and it also has the lowest discounted welfare among all the parameterizations. As noted in Section 5.3.4, high-passion activists tend to rely on confrontation to a greater degree than low-passion activists, so the direct effect of confrontation is especially strong for these parameterizations.

The results in Table 8 depend, of course, on the choice of the discount factor. Increasing the discount factor gives more weight to long-run benefit flows. Table 9 recalculates the discounted net social benefit with β_S set to 0.99. In this case, the relative social advantage of the activist is magnified. We summarize our findings as follows:

Result 12 *Discounted net social benefit is higher with an activist than without.*

The implicit benchmark in our model is a setting in which public policy is unable to force the firm to adopt a level of externality reduction in excess of the one that maximizes its long-run value. This benchmark is relevant to circumstances in which the institutions of public governance are likely to be weak. Our analysis suggests that in such cases activist groups that create reputational risks for firms can be a salutary force. For example, activist groups that pressure global firms operating in developing countries to abate environmental damage may be able to induce welfare improvements that could not be otherwise be attained through formal national institutions of governance. To the extent that globalization has tended to shift manufacturing activities from developed countries to countries with weaker forms of public regulation, the potential benefit of private regulation induced in response to activist-driven reputational risk becomes even more important, and the potential social value of activists becomes even greater.

presented earlier, the assumed starting state is $R_0 = 15$. Finally, we approximate $\lim_{T \rightarrow \infty}$ by setting $T = 64$.

7 Summary and conclusions

We model the interaction between a firm and an activist using a discrete-time, infinite-horizon dynamic stochastic game. The firm is assumed to be profit maximizing while activists care about reducing a socially inefficient externality. The firm can engage in activity that reduces the externality and, with some probability, will receive an improvement in its corporate reputation, which enhances consumer demand. Activists can engage in two forms of costly activity: they can “criticize” the firm, which, with some probability, has a marginally negative impact on the firm’s reputation, or they can trigger a “crisis” which crashes the firm’s reputation.

While the firm has an incentive to invest in externality-reducing activity without the existence of an activist, this effort is subject to decreasing marginal returns in equilibrium. The incentive to “coast” when reputational equity is high creates a conflict between firm and activists. To prevent the firm from coasting activists, in most cases, engage in a combination of criticism and crisis inducing behavior. In equilibrium both crises and criticism typically occur with positive probability. This prevents the firm from coasting. That said, state-by-state the activist’s presence functions like a tax and *depresses* firm’s incentives to engage in corporate citizenship, which serves neither the firm’s nor the activist’s interests. However, the activists’ activities keep the firm motivated to supply externality reduction even in the long-run. In the case where the activist is effective, the trade-off between these incentives leads to a welfare enhancement in most cases, though these improvements are never first-best.

However, to the extent that such forms of private politics present an alternative regulatory mechanism any welfare comparisons need to be discussed in a broader context. On the one hand, we can consider such mechanisms in cases where traditional conditions for public regulation do not hold. For example, Pigouvian taxes or subsidies may be infeasible; collective action and information problems may make Coasian bargaining impractical; or governance problems may undermine public regulation. Such a perspective may be especially appropriate for globally operating firms with business operations in countries with weak or non-existent regulatory mechanisms. In that case activist pressure would serve as a (partial) substitute for public regulation. That said, activists also operate in mature economies with fully developed legal, political, and regulatory institutions. Still, activists increasingly have resorted to directly targeting firms to change business practice. Moreover, activists have stated publicly that such private politics campaigns are more effective than the traditional channel of pressuring elected officials (e.g. Baron and Diermeier 2007). To assess such claims a proper comparison would move beyond a traditional welfare analysis and compare mechanisms based on private politics with political economy models of public regulation, where public policy is the consequence of competition among politicians, interest groups, and voters in public arenas.

From a positive point of view we can investigate how the nature of the equilibrium depends on the parameters of the model such as the relative effectiveness of the two activist activities, the

returns to corporate citizenship, the discount parameters and so forth. For example, companies for whom corporate citizenship has a higher value are more inviting targets for activists. Moreover, activists are more effective when they both criticize and try to trigger crises. More patient activists rely more on confrontation, and more patient firms are more vulnerable to crises. Criticism and confrontation, however, are imperfect substitutes, and only in the case of criticism does effectiveness of that activity necessarily increase long-run externality-reducing activity by the firm. These implications, to the extent that they have been addressed by the existing literature, are broadly supported by the empirical literature.

Our approach left out many of the complexities regarding the interaction between firms and activists. For example, activists were limited to inflict harm on the firm, an assumption that, while empirically supported, ideally would be derived in equilibrium of a richer model. Correspondingly, it would be worthwhile to consider a socially motivated firm. Other natural extensions would allow for bargaining between firms and activists and consider multiple, competing firms and activists. That said, even in the simple model, the dynamic interactions between the firm and the activist proved surprisingly rich. We hope that more complex approaches can be developed on its foundation.

8 Appendix

8.1 Computational method

For each analytical experiment, we explore the graph of the equilibrium correspondence as the relevant parameters vary using the homotopy algorithm discussed in Besanko, Doraszelski, Kryukov, and Satterthwaite (2010). To explain the algorithm, let $\mathbf{X}^* \equiv (\mathbf{V}_F^*, \mathbf{V}_A^*, \mathbf{x}^*, \mathbf{z}^*, \mathbf{d}^*)$ denote the equilibrium vector, and let $\mathbf{H}^{-1} = \{\mathbf{X}^* | \mathbf{H}(\mathbf{X}^* | \Omega) = 0\}$ denote the equilibrium correspondence. To explore this correspondence, we follow “paths” along the surface by varying a single parameter, such as τ . The parameter that is varied is known as the homotopy parameter. The homotopy method starts with a pair of functions $(\mathbf{X}^*(s), \tau(s)) \in \mathbf{H}^{-1}$ given parametrically by a scalar s , which implies $\mathbf{H}(\mathbf{X}^*(s) | \tau(s), \Omega/\tau) = 0$, where Ω/τ is the set of all parameters remaining fixed as τ varies. To remain within on an equilibrium path, it is necessary that:

$$\frac{\partial \mathbf{H}(\mathbf{X}^*(s) | \tau(s), \Omega/\tau)}{\partial \mathbf{x}} \frac{d\mathbf{X}^*(s)}{ds} + \frac{\partial \mathbf{H}(\mathbf{X}^*(s) | \tau(s), \Omega/\tau)}{\partial \tau} \tau'(s) = \mathbf{0}, \quad (18)$$

where $\frac{\partial \mathbf{H}(\mathbf{X}^*(s) | \tau(s), \Omega/\tau)}{\partial \mathbf{x}}$ is the $(8\bar{R} \times 8\bar{R})$ Jacobian, $\frac{d\mathbf{X}^*(s)}{ds}$ and $\frac{\partial \mathbf{H}(\mathbf{X}^*(s) | \tau(s), \Omega/\tau)}{\partial \tau}$ are $(8\bar{R} \times 1)$ vectors, and $\tau'(s)$ is scalar valued. This is a system of $8\bar{R} + 1$ differential equations that must be solved in order to identify a path.

The homotopy algorithm is not guaranteed to find all the MPE. This is because \mathbf{H}^{-1} may contain equilibria that are off the main path. To identify additional equilibria, we use the Pakes-McGuire algorithm at a variety of different starting values. In addition, we can choose other parameters besides τ to be the homotopy parameter. By using, for example, κ as the homotopy parameter for a fixed value of τ , we can “crisscross” the parameter space by using equilibria on the τ paths to generate paths with respect to κ . A κ path must either intersect with all τ paths, or they will lead us to additional equilibria that in turn can give us an initial condition to generate an additional τ

path.

To compute equilibria, we use Hompack written in Fortran 90. Our programs are available upon request.

8.2 Proofs of propositions

Proof of Proposition 1:

Characterization of the solution to the firm's problem and proof that the solution is unique:

When there is no activist, (2) simplifies to

$$(1 - \beta_F)V_F^*(R) = \frac{(e_0\bar{R}^\theta - c)^2}{4} + \max_{x \geq 0} \left\{ -kx + \frac{\eta x \beta_F}{1 + \eta x} [V_F^*(R+1) - V_F^*(R)] \right\}, \quad (19)$$

and the Kuhn-Tucker condition becomes

$$\frac{\beta_F \eta}{(1 + \eta x)^2} \{V_F^*(R+1) - V_F^*(R)\} \leq k, \quad (20)$$

which holds with equality if $x^*(R) > 0$. Now, at $R = \bar{R}$, $V_F^*(\bar{R}+1) - V_F^*(\bar{R})$ so $x^*(\bar{R}) = 0$.

Substituting $x = 0$ into (19) implies $V_F^*(\bar{R}) = \frac{(e_0\bar{R}^\theta - c)^2}{4(1 - \beta_F)}$.

The derivation of (14) and (15), and the proof that the MPE is unique, is by induction. Consider an arbitrary $R < \bar{R}$, and suppose $x^*(R+1)$ and $V_F^*(\bar{R}+1)$ are the unique (x, V_F) satisfying satisfy (14) and (15). Now, for state R , consider the maximization problem in (19). The solution to this maximization problem is:

$$x = \begin{cases} 0 & \text{if } \frac{\beta_F \eta}{k} [V_F^*(R+1) - V_F] < 1 \\ \frac{1}{\eta} \left(\left\{ \frac{\beta_F \eta}{k} [V_F^*(R+1) - V_F] \right\}^{\frac{1}{2}} - 1 \right) & \text{if } \frac{\beta_F \eta}{k} [V_F^*(R+1) - V_F] \geq 1. \end{cases} \quad (21)$$

but this expression is equivalent to (14). If we substitute (21) into (19) and rearrange terms, we get (15).

To prove that the solution to (14) and (15) is unique, notice that (21)—which, recall, is equivalent to (14)—traces out a locus in (x, V_F) space. This locus has two pieces. For $V_F > V_F^*(R+1) - \frac{k}{\eta\beta_F}$, this locus coincides with the vertical axis. For $V_F \leq V_F^*(R+1) - \frac{k}{\eta\beta_F}$, the locus is traced out by the equation $V_F^\#(x) = V_F^*(R+1) - \frac{k(1+\eta x)^2}{\beta_F \eta}$, which is strictly decreasing in x when $x \geq 0$. Condition (15) also traces out a locus in (x, V_F) space, and this locus, denoted by $\widehat{V}_F(x) = \frac{(e_0 R^\theta - c)^2}{4(1 - \beta_F)} + \frac{k\eta x^2}{(1 - \beta_F)}$, is monotone increasing in x and takes on a value of $\frac{(e_0 R^\theta - c)^2}{4(1 - \beta_F)}$ when $x = 0$. There are two possibilities. If $\frac{(e_0 R^\theta - c)^2}{4(1 - \beta_F)} > V_F^*(R+1) - \frac{k}{\eta\beta_F}$, the intersection of the two loci occurs at $x = 0$ and $V_F = \frac{(e_0 R^\theta - c)^2}{4(1 - \beta_F)}$, so $x^*(R) = 0$ and $V_F^*(R) = \frac{(e_0 R^\theta - c)^2}{4(1 - \beta_F)}$. If $\frac{(e_0 R^\theta - c)^2}{4(1 - \beta_F)} < V_F^*(R+1) - \frac{k}{\eta\beta_F}$, the intersection of the two loci occurs at x such that where $\widehat{V}_F(x) - V_F^\#(x) = \frac{(e_0 R^\theta - c)^2}{4(1 - \beta_F)} + \frac{k\eta x^2}{(1 - \beta_F)} + \frac{k(1+\eta x)^2}{\beta_F \eta} - V_F^*(R+1) = 0$. It is straightforward to establish that this quadratic equation has a unique positive root, $x^*(R)$. This, in turn, implies that $V_F^*(R)$ is unique.

Proof that the firm's value function is strictly increasing in R : Suppose, to the contrary, that

$V_F^*(R+1) \leq V_F^*(R)$. From the Kuhn-Tucker conditions in (20), it would follow that $x^*(R) = 0$, and from (15) in state R , we would have:

$$V_F^*(R) = \frac{[e_0 R^\theta - c]^2}{4(1 - \beta_F)}. \quad (22)$$

Now, since $x^*(R+1) \geq 0$, (15) in state $R+1$ implies that

$$V_F^*(R+1) \geq \frac{[e_0 (R+1)^\theta - c]^2}{4(1 - \beta_F)}. \quad (23)$$

Comparing (22) and (23), we have $V_F^*(R+1) > V_F^*(R)$, a contradiction. ■

Proof that the firm's externality-reducing activity is non-increasing in R :

The proof is by induction. Note that $0 = x^*(\bar{R}) \leq x^*(\bar{R} - 1)$, establishing the result at $R = \bar{R} - 1$. Assume, then, $x^*(R+2) \leq x^*(R+1)$. There are two cases to consider: $x^*(R) > 0$ and $x^*(R) = 0$. Consider the first case, $x^*(R) > 0$. In this case, we want to establish that $x^*(R+1) < x^*(R)$. Suppose, contrary to what we want to prove, that $x^*(R+1) \geq x^*(R)$. This, then, implies $x^*(R+1) > 0$, so $x^*(R+1)$ must therefore satisfy (20) with equality in state $R+1$:

$$\frac{\beta_F \eta}{[1 + \eta x^*(R+1)]^2} [V_F^*(R+2) - V_F^*(R+1)] = k, \quad (24)$$

Similarly, since $x^*(R) > 0$:

$$\frac{\beta_F \eta}{[1 + \eta x^*(R)]^2} [V_F^*(R+1) - V_F^*(R)] = k. \quad (25)$$

Now, from (15) we have

$$V_F^*(R+2) - V_F^*(R+1) = \frac{[e_0 (R+2)^\theta - c]^2}{4(1 - \beta_F)} - \frac{[e_0 (R+1)^\theta - c]^2}{4(1 - \beta_F)} + \frac{\eta k [x^*(R+2)]^2}{1 - \beta_F} - \frac{\eta k [x^*(R+1)]^2}{1 - \beta_F}. \quad (26)$$

$$V_F^*(R+1) - V_F^*(R) = \frac{[e_0 (R+1)^\theta - c]^2}{4(1 - \beta_F)} - \frac{[e_0 R^\theta - c]^2}{4(1 - \beta_F)} + \frac{\eta k [x^*(R+1)]^2}{1 - \beta_F} - \frac{\eta k [x^*(R)]^2}{1 - \beta_F}. \quad (27)$$

Substitute (26) into the left-hand side of (24) and (27) into the left-hand side of (25), equate the resulting expressions, and rearrange terms to get:

$$\left[\begin{array}{l} [1 + \eta x^*(R+1)]^{-2} \left\{ \begin{array}{l} [e_0 (R+2)^\theta - c]^2 \\ - [e_0 (R+1)^\theta - c]^2 \end{array} \right\} \\ - [1 + \eta x^*(R)]^{-2} \left\{ \begin{array}{l} [e_0 (R+1)^\theta - c]^2 \\ - [e_0 R^\theta - c]^2 \end{array} \right\} \end{array} \right] = 4\eta k \left[\begin{array}{l} [1 + \eta x^*(R)]^{-2} \left(\begin{array}{l} [x^*(R+1)]^2 - \\ [x^*(R)]^2 \end{array} \right) \\ - [1 + \eta x^*(R+1)]^{-2} \left(\begin{array}{l} [x^*(R+2)]^2 \\ - [x^*(R+1)]^2 \end{array} \right) \end{array} \right]. \quad (28)$$

Now, by assumption, $x^*(R+1) \geq x^*(R)$, so $[1 + \eta x^*(R+1)]^{-2} \leq [1 + \eta x^*(R)]^{-2}$. Moreover, given our parameter conditions, $(e_0 R^\theta - c)^2$ is an increasing, strictly concave function of R , so

$$0 < \left\{ \begin{array}{c} [e_0(R+2)^\theta - c]^2 \\ - [e_0(R+1)^\theta - c]^2 \end{array} \right\} < \left\{ \begin{array}{c} [e_0(R+1)^\theta - c]^2 \\ - [e_0 R^\theta - c]^2 \end{array} \right\}$$

Thus, the left-hand side of (28) is strictly negative, so

$$[1 + \eta x^*(R)]^{-2} \left(\begin{array}{c} [x^*(R+1)]^2 \\ [x^*(R)]^2 \end{array} - \right) < [1 + \eta x^*(R+1)]^{-2} \left(\begin{array}{c} [x^*(R+2)]^2 \\ - [x^*(R+1)]^2 \end{array} \right) \leq 0, \quad (29)$$

where the second inequality in (29) follows because, by the induction hypothesis, $x^*(R+2) \leq x^*(R+1)$. But (29) implies $x^*(R+1) < x^*(R)$, which contradicts the assumption that $x^*(R+1) \geq x^*(R)$. Thus, it must be the case that $x^*(R+1) < x^*(R)$ for the case of $x^*(R) > 0$.

Consider, now, the second case: $x^*(R) = 0$. In this case, we want to establish that $x^*(R+1) \leq x^*(R)$, which could only hold if $x^*(R+1) = 0$. So, suppose, to the contrary, that $x^*(R+1) > 0$. Since $x^*(R) = 0$, it follows from (15) that $V_F^*(R) = \frac{[e_0 R^\theta - c]^2}{4(1-\beta_F)}$. Moreover, $V_F^*(R+1) = \frac{[e_0 [R+1]^\theta - c]^2}{4(1-\beta_F)} + \frac{k\eta [x^*(R+1)]^2}{(1-\beta_F)}$. Thus, we get the following chain of implications:

$$\begin{aligned} \beta_F \eta [V_F^*(R+1) - V_F^*(R)] &= \beta_F \eta \left\{ \frac{[e_0 [R+1]^\theta - c]^2}{4(1-\beta_F)} + \frac{k\eta [x^*(R+1)]^2}{(1-\beta_F)} - \frac{[e_0 R^\theta - c]^2}{4(1-\beta_F)} \right\} \\ &\geq \beta_F \eta \left\{ \frac{[e_0 [R+1]^\theta - c]^2}{4(1-\beta_F)} + \frac{k\eta [x^*(R+2)]^2}{(1-\beta_F)} - \frac{[e_0 R^\theta - c]^2}{4(1-\beta_F)} \right\} \\ &> \frac{\beta_F \eta}{1 + \eta x^*(R+1)} \left\{ \frac{[e_0 [R+1]^\theta - c]^2}{4(1-\beta_F)} + \frac{k\eta [x^*(R+2)]^2}{(1-\beta_F)} - \frac{[e_0 R^\theta - c]^2}{4(1-\beta_F)} \right\} \\ &> \frac{\beta_F \eta}{1 + \eta x^*(R+1)} \left\{ \frac{[e_0 [R+2]^\theta - c]^2}{4(1-\beta_F)} + \frac{k\eta [x^*(R+2)]^2}{(1-\beta_F)} - \frac{[e_0 [R+1]^\theta - c]^2}{4(1-\beta_F)} \right\} \\ &> \frac{\beta_F \eta}{1 + \eta x^*(R+1)} \left\{ \frac{[e_0 [R+2]^\theta - c]^2}{4(1-\beta_F)} + \frac{k\eta [x^*(R+2)]^2}{(1-\beta_F)} \right. \\ &\quad \left. - \frac{[e_0 [R+1]^\theta - c]^2}{4(1-\beta_F)} - \frac{k\eta [x^*(R+1)]^2}{(1-\beta_F)} \right\} \\ &= \frac{\beta_F \eta}{1 + \eta x^*(R+1)} [V_F^*(R+2) - V_F^*(R+1)] \\ &= k \end{aligned}$$

The inequality in the second line follows from the induction hypothesis that $x^*(R+1) \geq x^*(R+2)$. The inequality in the third line follows because $\beta_F \eta > \frac{\beta_F \eta}{1 + \eta x^*(R+1)}$, since $x^*(R+1) > 0$ by assumption.

tion. The inequality in the fourth line follows because $[e_0R^\theta - c]^2$ is strictly concave in R . The inequality in the fifth line follows because $x^*(R+1) > 0$. The equality in the sixth line follows from (15), while the equality in the last line follows from the first-order condition for x in state $R+1$. But the implication of this chain of inequalities is that $\beta_F\eta[V_F^*(R+1) - V_F^*(R)] > k$, which contradicts the fact that when $x^*(R) = 0$, the Kuhn-Tucker condition would imply $\beta_F\eta[V_F^*(R+1) - V_F^*(R)] \leq k$. Summarizing, we have shown that if $x^*(R) > 0$, then $x^*(R) > x^*(R+1)$, and if $x^*(R) = 0$, then $x^*(R+1) = 0$. This is what we wanted to prove. ■

Proof that the firm's value function is strictly concave in R

From the Kuhn-Tucker condition (20)

$$V_F^*(R+1) - V_F^*(R) \leq \frac{k(1 + \eta x^*(R))^2}{\beta_F\eta} \quad (30)$$

$$V_F^*(R) - V_F^*(R-1) \leq \frac{k(1 + \eta x^*(R-1))^2}{\beta_F\eta}. \quad (31)$$

There are three cases to consider. First, suppose $x^*(R-1)$ and $x^*(R)$ are both positive. Then, the above conditions hold with equality. We know from Proposition ?? that $x^*(R-1) > x^*(R)$, which immediately implies $V_F^*(R) - V_F^*(R-1) > V_F^*(R+1) - V_F^*(R)$.

Second, suppose that $x^*(R) = 0$, but $x^*(R-1) > 0$. Then, (31) holds with equality, while (30) holds with inequality. This implies $V_F^*(R) - V_F^*(R-1) = \frac{k(1+\eta x^*(R-1))^2}{\beta_F\eta} > \frac{k(1+\eta x^*(R))^2}{\beta_F\eta} \geq V_F^*(R+1) - V_F^*(R)$.

Third, suppose that $x^*(R-1) = x^*(R) = 0$. From Proposition ??, it would follow that $x^*(R-1) = x^*(R) = x^*(R+1) = \dots = x^*(\bar{R}) = 0$. In this case, then from condition (15) in Proposition 1, we have $V_F^*(R-1) = \frac{(e_0[R-1]^\theta - c)^2}{4(1-\beta_F)}$, $V_F^*(R) = \frac{(e_0R^\theta - c)^2}{4(1-\beta_F)}$, and $V_F^*(R+1) = \frac{(e_0[R+1]^\theta - c)^2}{4(1-\beta_F)}$. Given our assumptions on θ , $(e_0R^\theta - c)^2$ is a strictly concave function in R , so $V_F^*(R+1) - V_F^*(R) < V_F^*(R) - V_F^*(R-1)$ in this case as well. ■

Proof of Proposition 2:

Suppose, to the contrary, that $x^*(R)$ is strictly increasing in R for all R . We will show that the solution to this problem is $z = d = 0$ in all states, which, in turn, will imply that $x^*(R)$ could not be strictly increasing in R . We begin by noting that if the activist sets $z = d = 0$ in all states, then (5) implies that the activist's value, denoted by $V_A^0(R)$, is given by the recursion:

$$V_A^0(R) = u(x^*(R)) + \beta_A [\phi_F(x^*(R))V_A^0(R+1) + (1 - \phi_F(x^*(R)))V_A^0(R)], \quad (32)$$

At $R = \bar{R}$,

$$V_A^0(\bar{R}) = \frac{u(x^*(\bar{R}))}{1 - \beta_A}, \quad (33)$$

since $V_A^0(\bar{R}+1) = V_A^0(\bar{R})$. Now, in state $\bar{R}-1$ the recursion in (32) is given by:

$$V_A^0(\bar{R}-1) = u(x^*(\bar{R}-1)) + \beta_A [\phi_F(x^*(\bar{R}-1))V_A^0(\bar{R}) + (1 - \phi_F(x^*(\bar{R}-1)))V_A^0(\bar{R}-1)].$$

Rearranging terms gives us:

$$V_A^0(\bar{R}-1) = \frac{u(x^*(\bar{R}-1))}{[1 - \beta_A(1 - \phi_F(x^*(\bar{R}-1)))]} + \frac{\beta_A\phi_F(x^*(\bar{R}-1))V_A^0(\bar{R})}{[1 - \beta_A(1 - \phi_F(x^*(\bar{R}-1)))]}.$$

Substituting (33) in place of $V_A^0(\bar{R})$ in the above expression, and rearranging terms, gives us:

$$V_A^0(\bar{R} - 1) = \left(\frac{1}{1 - \beta_A} \right) \{ \tau_1^*(R)u(x^*(\bar{R} - 1)) + (1 - \tau_1^*(R))u(x^*(\bar{R})) \}, \quad (34)$$

where $\tau_1^*(R) \equiv \frac{1 - \beta_A}{1 - \beta_A + \beta_A \phi_F(x^*(\bar{R} - 1))} \in (0, 1)$. Since $u(x)$ is non-decreasing and because we have assumed $x^*(R - 1) < x^*(R)$, (34) implies $V_A^0(\bar{R} - 1) \leq \frac{u(x^*(\bar{R}))}{1 - \beta_A} = V_A^0(\bar{R})$.

Consider, now, the recursion for $V_A^0(\cdot)$ in state $\bar{R} - 2$:

$$V_A^0(\bar{R} - 2) = u(x^*(\bar{R} - 2)) + \beta_A [\phi_F(x^*(\bar{R} - 2))V_A^0(\bar{R} - 1) + (1 - \phi_F(x^*(\bar{R} - 2)))V_A^0(\bar{R} - 2)].$$

Rearranging terms gives us

$$V_A^0(\bar{R} - 2) = \left(\frac{1}{1 - \beta_A} \right) \{ \tau_2^*(R)u(x^*(\bar{R} - 2)) + (1 - \tau_2^*(R))V_A^0(\bar{R} - 1) \},$$

where $\tau_2^*(R) \equiv \frac{1 - \beta_A}{1 - \beta_A + \beta_A \phi_F(x^*(\bar{R} - 2))}$. Substituting (34) into the above expression for $V_A^0(\bar{R} - 2)$ yields

$$V_A^0(\bar{R} - 2) = \left(\frac{1}{1 - \beta_A} \right) \left[\begin{array}{c} \tau_2^*(R)u(x^*(\bar{R} - 2)) \\ + (1 - \tau_2^*(R)) \left\{ \begin{array}{c} \tau_1^*(R)u(x^*(\bar{R} - 1)) \\ + (1 + \tau_1^*(R))u(x^*(\bar{R})) \end{array} \right\} \end{array} \right]. \quad (35)$$

Since $u(x^*(\bar{R} - 2)) \leq u(x^*(\bar{R} - 1)) \leq u(x^*(\bar{R}))$, (34) and (35) imply $V_A^0(\bar{R} - 2) \leq V_A^0(\bar{R} - 1)$. Reasoning inductively in this fashion for all R tells us that when $z = d = 0$ for all R ,

$$V_A^0(1) \leq \dots \leq V_A^0(\bar{R}).$$

Given this, along with equations (8) and (9), the activist's marginal benefit for z is non-positive for all $z > 0$, and the activist's marginal benefit for d is also non-positive for all $d > 0$. This implies that $z^*(R) = d^*(R) = 0$, for all R . Thus, if $x^*(R)$ is strictly increasing, the activist will not engage in criticism or confrontation in any state.

However, if the activist sets $z = d = 0$ in all states, the firm's maximization problem is solved by choosing the level of externality-reducing activity as in the no-activist case. By Proposition ??, we have seen that $x^*(R)$ in that case is non-increasing, which contradicts our assumption that $x^*(R)$ is monotone increasing in R . ■

Proof of Lemma 1:

With $z(R) = 0$ and an exogenous perturbation $\phi_\Delta^n > 0$ in state R_n , the firm's optimization problem in state R_n can be written as

$$\begin{aligned} V_F(R_n) &= \max_{x \geq 0} \frac{(e_0 R_n^\theta - c)^2}{4} - kx + \beta_F (1 - \phi_\Delta^n) V_F(R_n) \\ &\quad + \beta_F (1 - \phi_\Delta^n) \phi_F(x) [V_F(R_n + 1) - V_F(R_n)] + \beta_F \frac{\phi_\Delta^n}{R_n - 1} \sum_{r=1}^{R_n - 1} V_F(r). \end{aligned} \quad (36)$$

The firm's optimization in a non-focal state $R \in \{1, \dots, R_{n-1}, R_n + 1, \dots, \bar{R} - 1\}$ is:

$$V_F(R) = \max_{x \geq 0} \frac{(e_0 R^\theta - c)^2}{4} - kx + \beta_F V_F(R) + \beta_F \phi_F(x) [V_F(R + 1) - V_F(R)]. \quad (37)$$

The firm's optimization in state \bar{R} is

$$V_F(\bar{R}) = \max_{x \geq 0} \frac{(e_0 \bar{R}^\theta - c)^2}{4} - kx + \beta_F V_F(\bar{R}). \quad (38)$$

The solution in state \bar{R} is $x(\bar{R}) = 0$, and from this it follows that $V_F(\bar{R}) = \frac{(e_0 \bar{R}^\theta - c)^2}{4(1 - \beta_F)}$, which is independent of ϕ_Δ^n . Thus, $\frac{\partial V_F(\bar{R})}{\partial \phi_\Delta^n} = 0$.³⁷

Now consider the firm's optimization in a non-focal states $R > R_n$ and $R + 1 > R_n$. In both states, differentiate condition (37) with respect to ϕ_Δ^n , and evaluate at $\phi_\Delta^n = 0$. Utilizing the envelope theorem and rearranging terms gives us:

$$\begin{aligned} \left. \frac{\partial V_F(R)}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} &= \frac{\beta_F \phi_F(x_0^*(R))}{1 - \beta_F} \left. \frac{\partial [V_F(R+1) - V_F(R)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} \\ \left. \frac{\partial V_F(R+1)}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} &= \frac{\beta_F \phi_F(x_0^*(R+1))}{1 - \beta_F} \left. \frac{\partial [V_F(R+2) - V_F(R+1)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0}. \end{aligned}$$

Subtracting these expressions and rearranging terms gives us:

$$\left. \frac{\partial [V_F(R+1) - V_F(R)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = \frac{\beta_F \phi_F(x_0^*(R+1))}{1 - [1 - \phi_F(x_0^*(R))] \beta_F} \left. \frac{\partial [V_F(R+2) - V_F(R+1)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0}. \quad (39)$$

Evaluating this at $R = \bar{R} - 1$ gives us

$$\left. \frac{\partial [V_F(\bar{R}) - V_F(\bar{R} - 1)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = \frac{\beta_F \phi_F(x_0^*(\bar{R}))}{1 - [1 - \phi_F(x_0^*(\bar{R} - 1))] \beta_F} \left. \frac{\partial [V_F(\bar{R} + 1) - V_F(\bar{R})]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = 0,$$

where the second equality follows from the fact that $x_0^*(\bar{R}) = 0$. Using (39), we can reason recursively and deduce that $\left. \frac{\partial [V_F(R+1) - V_F(R)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = 0$ for all $R > R_n$. This establishes part (a) of the lemma.

Now in the focal state R_n , differentiate (36) with respect to ϕ_Δ^n , utilize the envelope theorem, and evaluate at $\phi_\Delta^n = 0$ to get:

$$\begin{aligned} \left. \frac{\partial V_F(R_n)}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} &= -\beta_F \left[V_{F0}^*(R_n) - \frac{\sum_{r=1}^{R_n-1} V_{F0}^*(r)}{R_n - 1} \right] + \beta_F \left. \frac{\partial V_F(R_n)}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} \\ &\quad + \beta_F \phi_F(x_0^*(R_n)) \left. \frac{\partial [V_F(R_n + 1) - V_F(R_n)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0}. \end{aligned} \quad (40)$$

Now, do the same for state $R_n + 1$ and rearrange terms:

$$\left. \frac{\partial V_F(R_n + 1)}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = \frac{\beta_F \phi_F(x_0^*(R_n + 1))}{1 - \beta_F} \left. \frac{\partial [V_F(R_n + 2) - V_F(R_n + 1)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = 0,$$

where the equality to zero follows from the earlier result that $\left. \frac{\partial [V_F(R+1) - V_F(R)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = 0$ for $R > R_n$.

³⁷Throughout the proof, we suppress dependence of $V_F(\cdot)$ on ϕ_Δ^n where there is no ambiguity.

Thus, condition (40) implies

$$\left. \frac{\partial V_F(R_n)}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = -\frac{\beta_F}{1-\beta_F} \left[V_{F0}^*(R_n) - \frac{\sum_{r=1}^{R_n-1} V_{F0}^*(r)}{R_n-1} \right] < 0, \quad (41)$$

since $V_{F0}^*(R_n) - \frac{\sum_{r=1}^{R_n-1} V_{F0}^*(r)}{R_n-1} > 0$ from the result in Proposition 1 that $V_{F0}^*(R_n)$ is monotone increasing in R . Hence, $\left. \frac{\partial [V_F(R_{n+1}) - V_F(R_n)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = \frac{\beta_F}{1-\beta_F} \left[V_{F0}^*(R_n) - \frac{\sum_{r=1}^{R_n-1} V_{F0}^*(r)}{R_n-1} \right] > 0$, establishing part (b) of the lemma.

Finally, consider states $R < R_n$. Differentiating (37) with respect to ϕ_Δ^n in these states and using the envelope theorem gives us, as before,

$$\left. \frac{\partial [V_F(R+1) - V_F(R)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = \frac{\beta_F \phi_F(x_0^*(R+1))}{1 - [1 - \phi_F(x_0^*(R))] \beta_F} \left. \frac{\partial [V_F(R+2) - V_F(R+1)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0}.$$

Evaluating this at $R = R_n - 1$ yields

$$\left. \frac{\partial [V_F(R_n) - V_F(R_n - 1)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} = \frac{\beta_F \phi_F(x_0^*(R_n))}{1 - [1 - \phi_F(x_0^*(R_n - 1))] \beta_F} \left. \frac{\partial [V_F(R_n + 1) - V_F(R_n)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} > 0,$$

since we have already established that $\left. \frac{\partial [V_F(R_n+1) - V_F(R_n)]}{\partial \phi_\Delta^n} \right|_{\phi_\Delta^n=0} > 0$. Recursively applying this in all states below R_n establishes part (c) of the lemma. ■

Proof of Proposition 4: Note that if $\phi_\Delta^n = 1$, then $MB_x(x, \mathbf{V}_F(\mathbf{R}|\phi_\Delta^n), \phi_\Delta^n | R_n) < 0$. This implies $x^*(R_n) = 0$. Since, by assumption, $x_0^*(R) > 0$, the perturbation unambiguously reduces the firm's choice of x in this state.

Proof of Proposition 6: This result follows directly from the data in Property 2 of Table 2.

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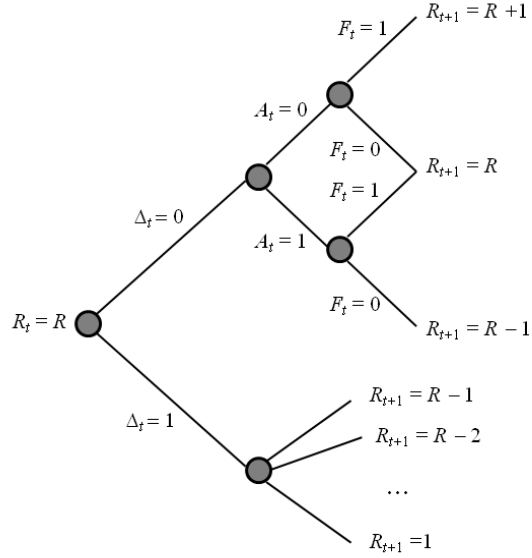


Figure 1: Stochastic process for \tilde{R}

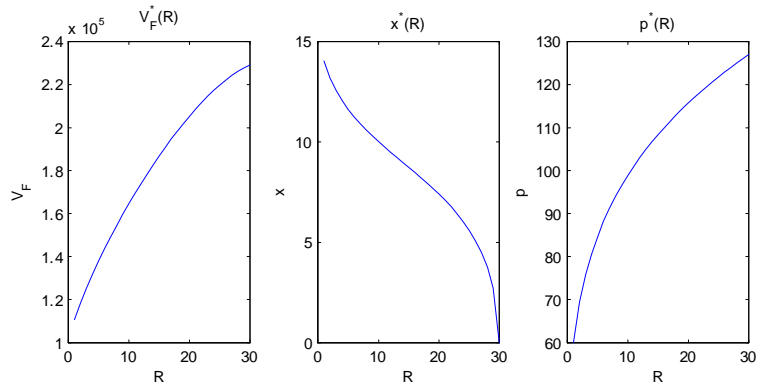


Figure 2: No activist equilibrium: baseline parameter values

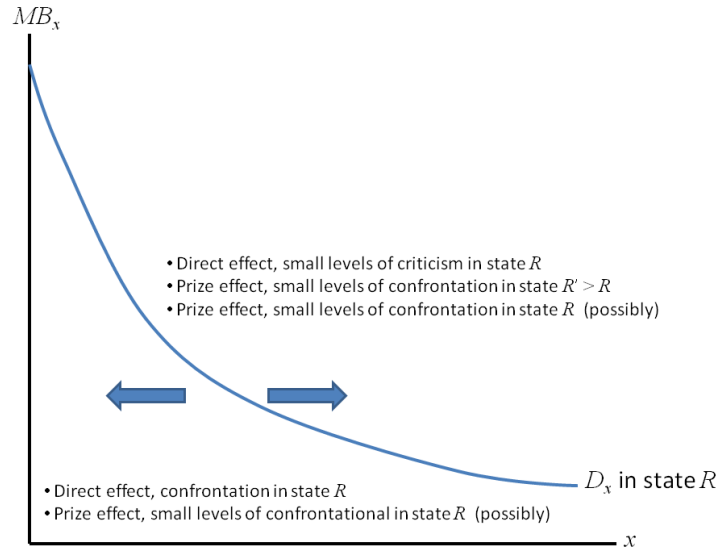


Figure 3: How the effects of activist behavior can shift the firm’s “demand curve” for externality-reducing investment.

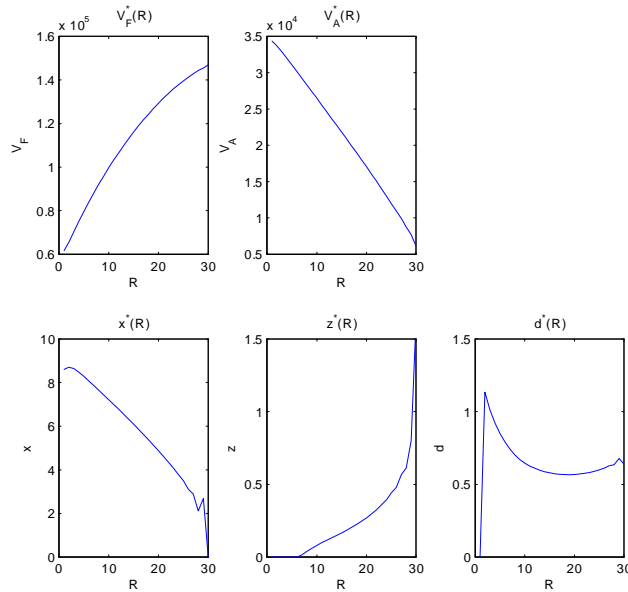


Figure 4: Equilibrium policy and value functions with an activist: baseline parameters

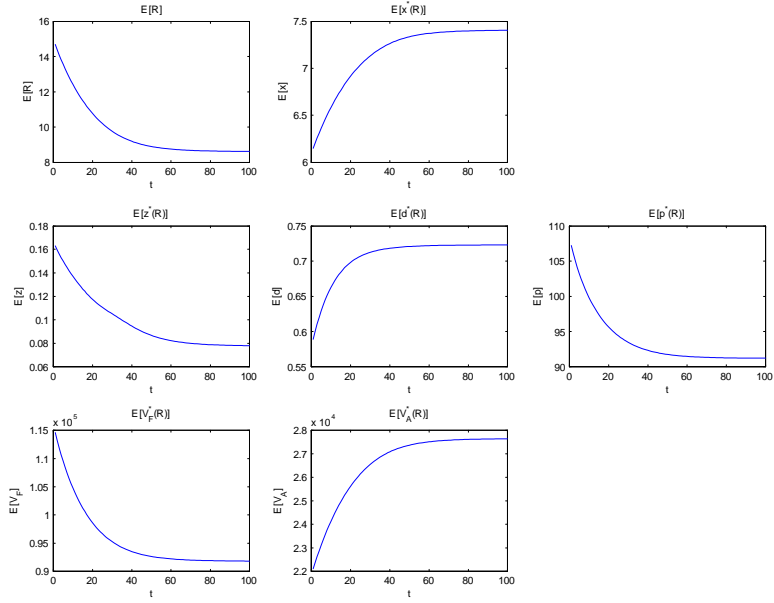


Figure 5: Equilibrium dynamics with an activist: baseline parameters

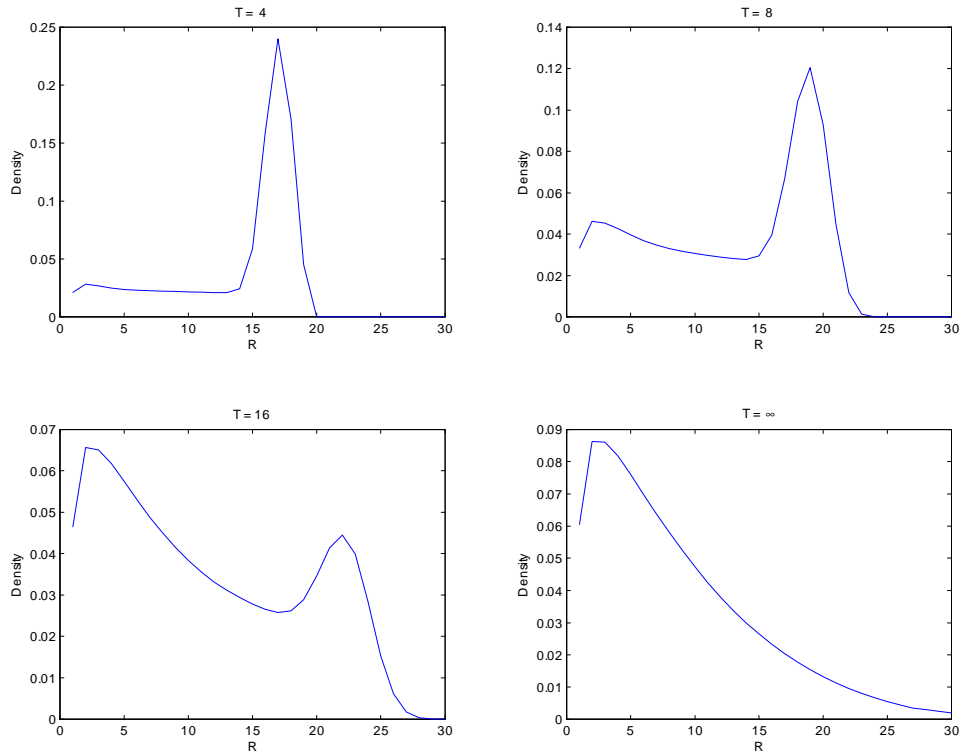


Figure 6: Transient distributions over the firm's reputation R : baseline parameters

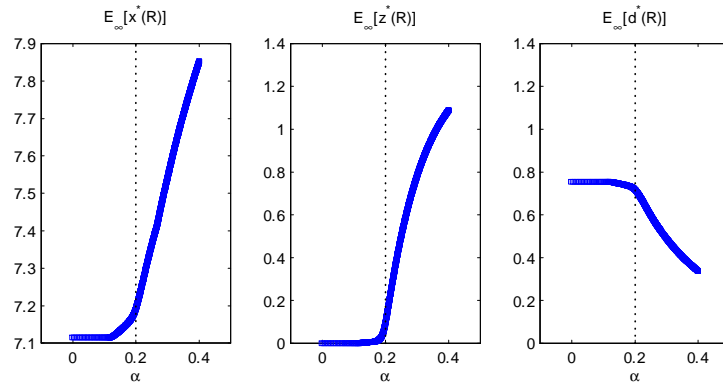


Figure 7: How $\mathbb{E}_\infty[x^*(R)]$, $\mathbb{E}_\infty[z^*(R)]$, and $\mathbb{E}_\infty[d^*(R)]$ vary with α

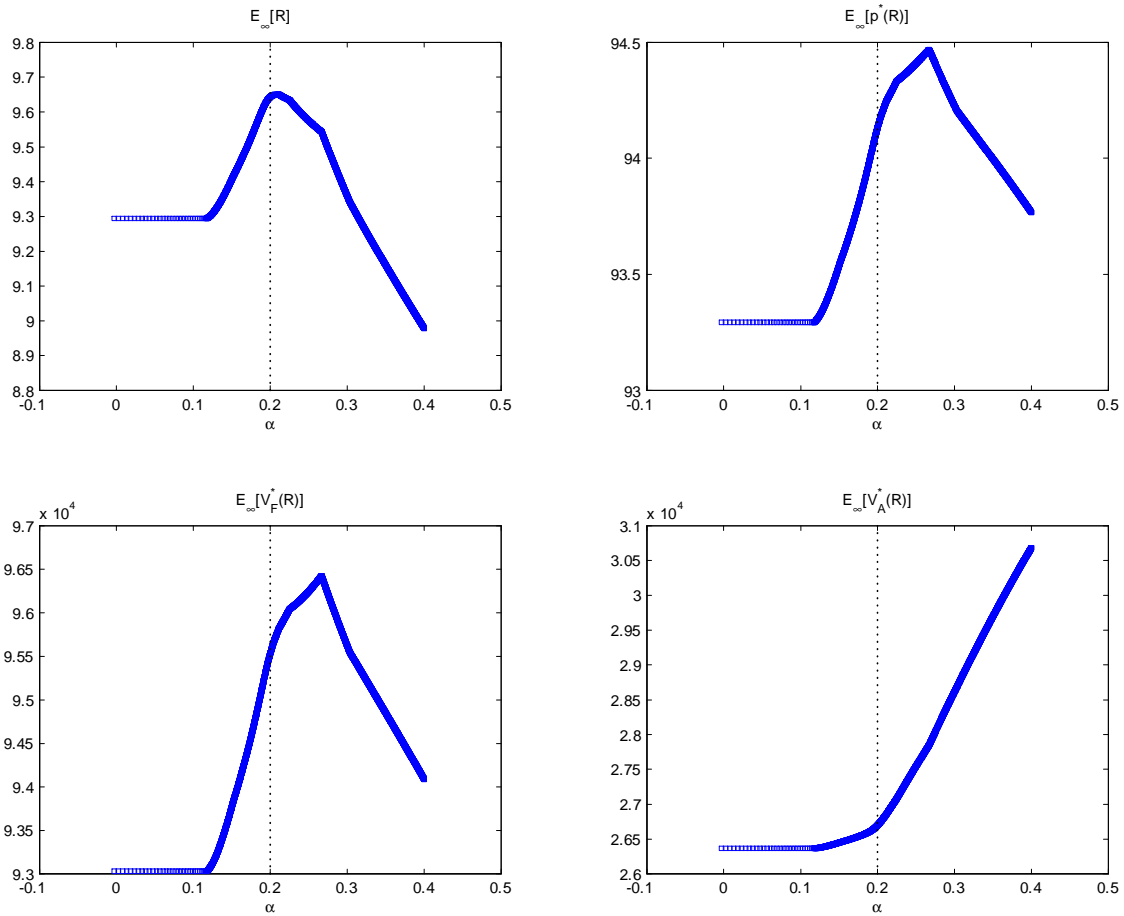


Figure 8: How $\mathbb{E}_\infty[R]$, $\mathbb{E}_\infty[p^*(R)]$, $\mathbb{E}_\infty[V_F^*(R)]$, and $\mathbb{E}_\infty[V_A^*(R)]$ vary with α .

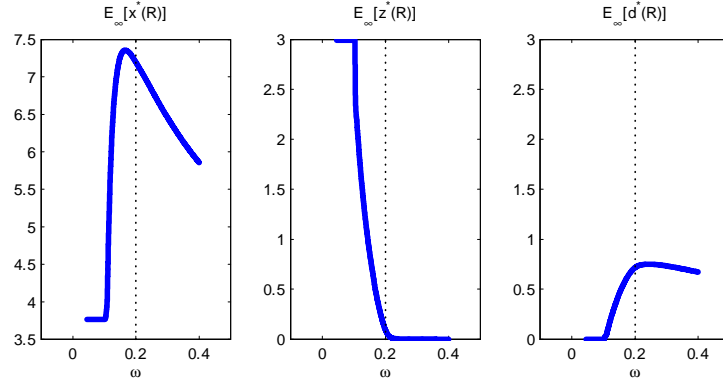


Figure 9: How $\mathbb{E}_\infty[x^*(R)]$, $\mathbb{E}_\infty[z^*(R)]$, and $\mathbb{E}_\infty[d^*(R)]$ vary with ω .

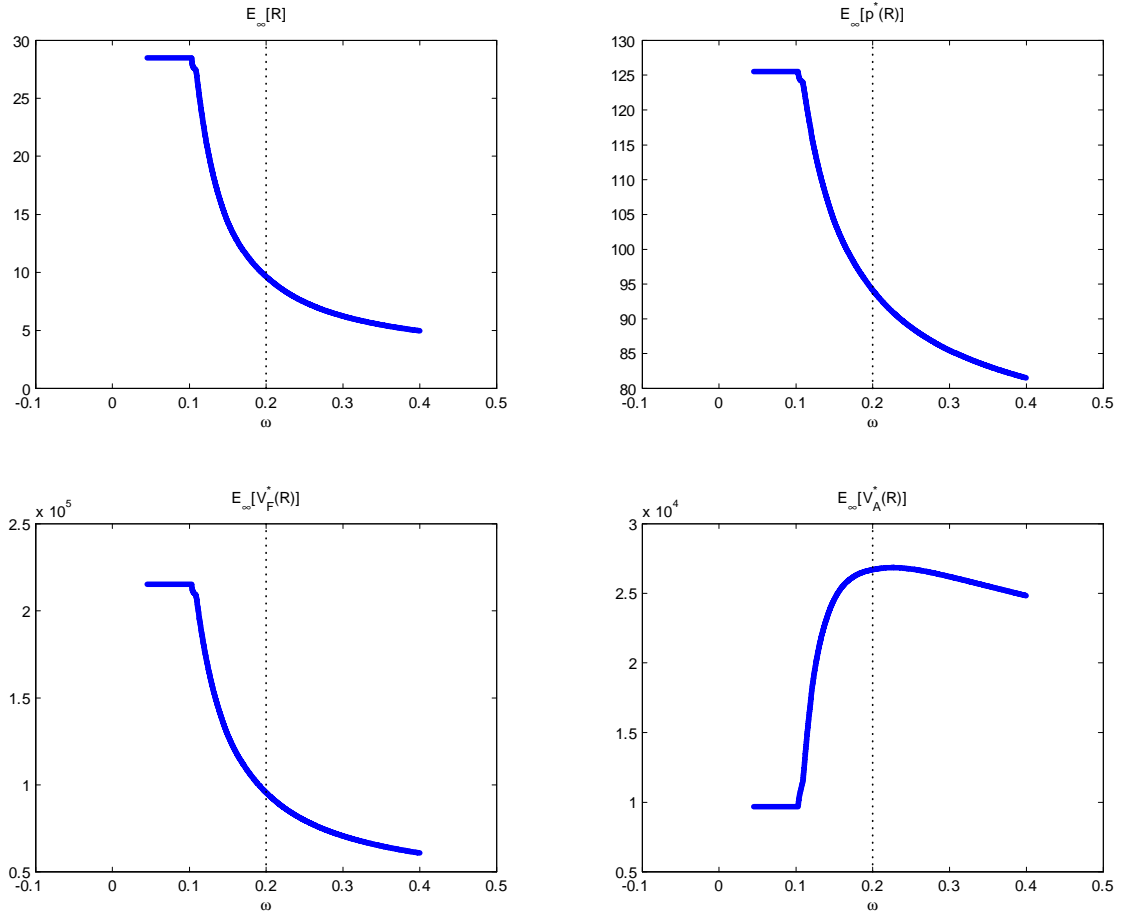


Figure 10: How $\mathbb{E}_\infty[R]$, $\mathbb{E}_\infty[p^*(R)]$, $\mathbb{E}_\infty[V_F^*(R)]$, and $\mathbb{E}_\infty[V_A^*(R)]$ vary with ω .

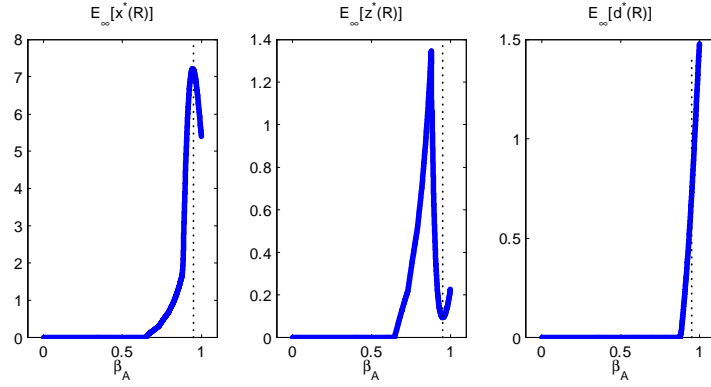


Figure 11: How $\mathbb{E}_\infty[x^*(R)]$, $\mathbb{E}_\infty[z^*(R)]$, and $\mathbb{E}_\infty[d^*(R)]$ vary with β_A

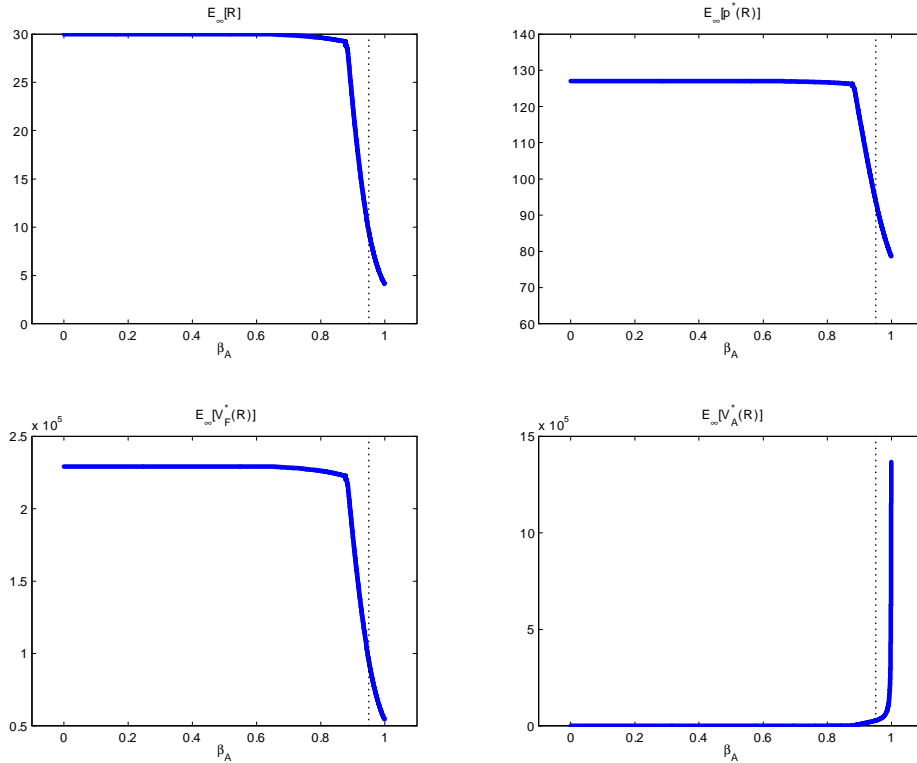


Figure 12: How $\mathbb{E}_\infty[R]$, $\mathbb{E}_\infty[p^*(R)]$, $\mathbb{E}_\infty[V_F^*(R)]$, and $\mathbb{E}_\infty[V_A^*(R)]$ vary with β_A .

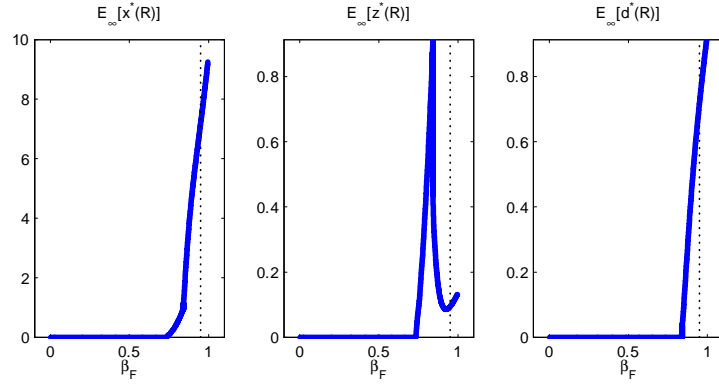


Figure 13: How $\mathbb{E}_\infty[x^*(R)]$, $\mathbb{E}_\infty[z^*(R)]$, and $\mathbb{E}_\infty[d^*(R)]$ vary with β_F .

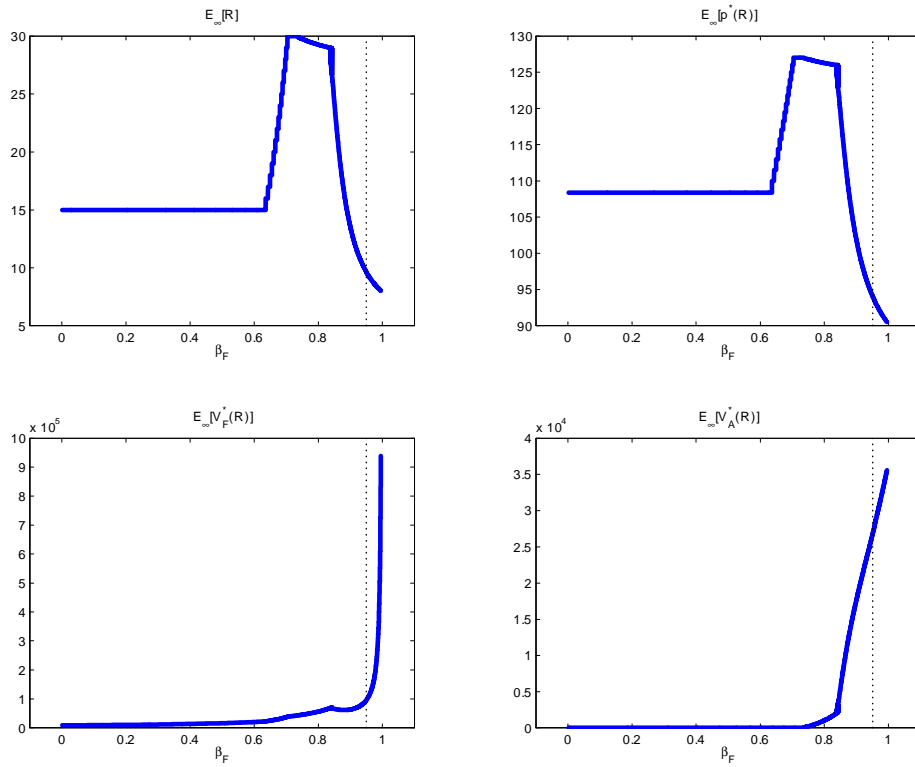


Figure 14: How $\mathbb{E}_\infty[R]$, $\mathbb{E}_\infty[p^*(R)]$, $\mathbb{E}_\infty[V_F^*(R)]$, and $\mathbb{E}_\infty[V_A^*(R)]$ vary with β_F .

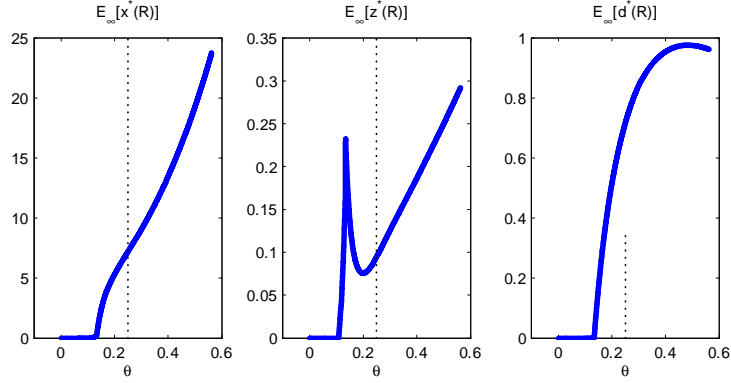


Figure 15: How $\mathbb{E}_\infty[x^*(R)]$, $\mathbb{E}_\infty[z^*(R)]$, and $\mathbb{E}_\infty[d^*(R)]$ vary with θ .

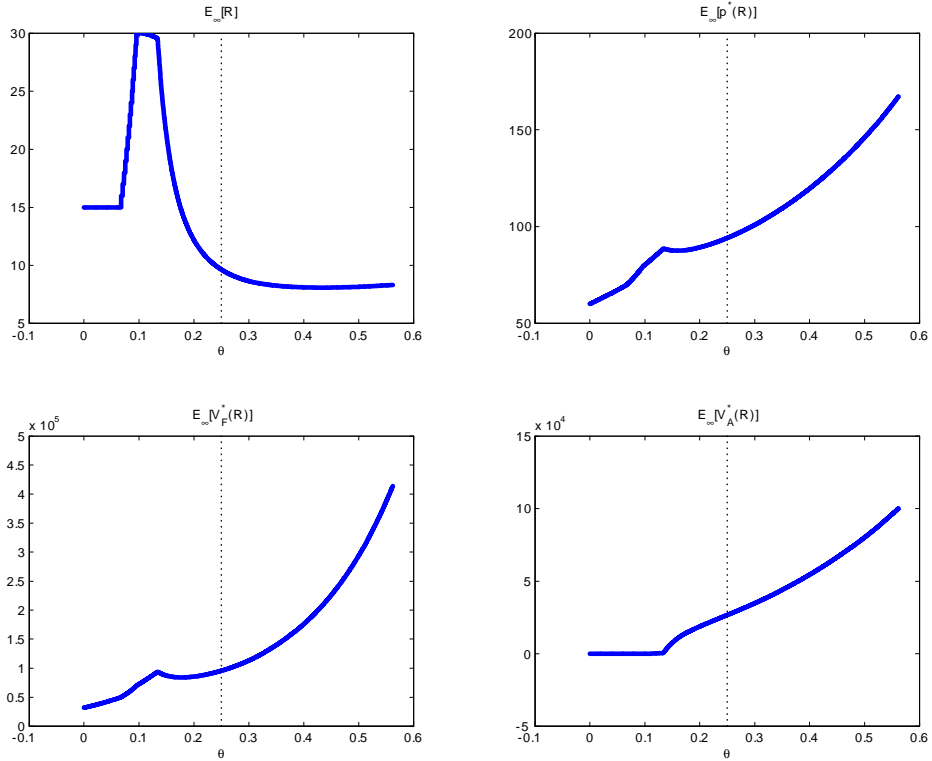


Figure 16: How $\mathbb{E}_\infty[R]$, $\mathbb{E}_\infty[p^*(R)]$, $\mathbb{E}_\infty[V_F^*(R)]$, and $\mathbb{E}_\infty[V_A^*(R)]$ vary with θ .

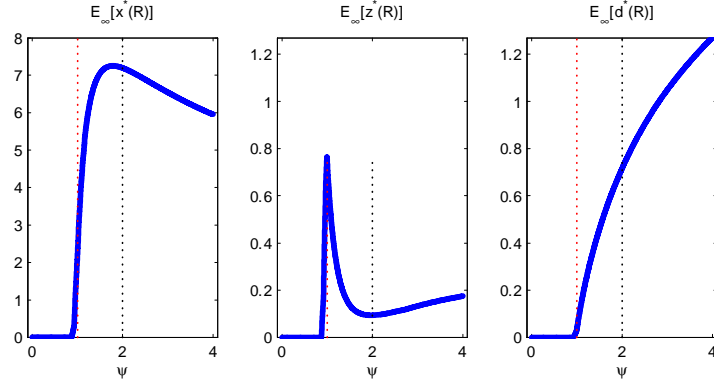


Figure 17: How $\mathbb{E}_\infty[x^*(R)]$, $\mathbb{E}_\infty[z^*(R)]$, and $\mathbb{E}_\infty[d^*(R)]$ vary with ψ .

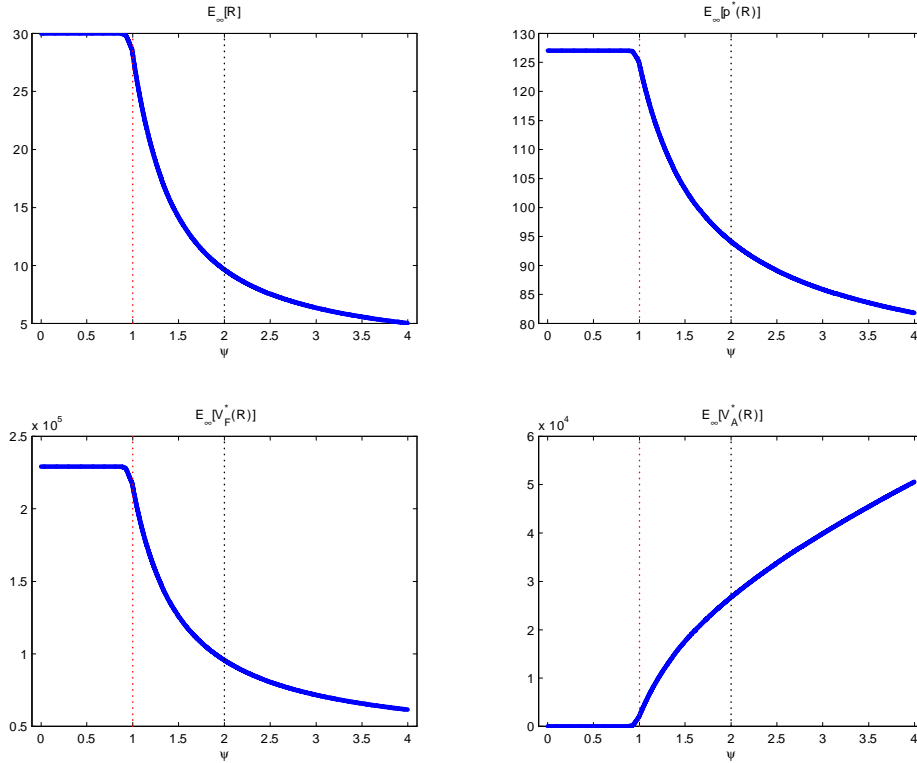


Figure 18: How $\mathbb{E}_\infty[R]$, $\mathbb{E}_\infty[p^*(R)]$, $\mathbb{E}_\infty[V_F^*(R)]$, and $\mathbb{E}_\infty[V_A^*(R)]$ vary with ψ .