Private Politics and Public Interest: NGOs, Corporate Campaigns, and Social Welfare

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Abstract

We provide a model of the interaction between a profit-maximizing firm and an activist. Firms care about their reputation with customers, and the reputation of a firm can be enhanced through private regulation, i.e. voluntary activities that reduces a negative externality. Activists can damage the firm's reputation through corporate campaigns. The presence of an 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. We solve for the equilibria of the dynamic game and assess the welfare consequences of activist activities.

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. But in recent decades *private politics* has emerged as a new regulatory mechanism (e.g. Baron 2001, Baron 2003, Baron 2012, Baron and Diermeier 2007, Feddersen and Gilligan 2001, Ingram, Yue, and Rao, 2010, King and McDonnell 2012, King and Pearce 2010).[1] In contrast to traditional regulation private politics does not operate through public institutions such as legislatures, courts, or executive agencies. Rather, it is characterized by the interaction of private entities such as firms, activists and NGOs. Despite its private nature it plays a growing role in the regulation of global commerce. For example 14 percent of the world's temperate forests and seven percent of global fisheries are governed by private certification systems (Vandenbergh 2013). Issues that have given rise to various forms and levels of private regulation include environmental protection, human rights, discrimination, working conditions, data privacy, safety of employees and customers, endangered species, and animal welfare.

While sometimes private regulation is eventually codified in governmental regulation, there are increasingly many examples where industries adopt explicit standards of private regulatory systems without any reference to governmental actors. Examples are the Equator Principles or the Sustainable Forestry Initiative. Private regulation is particularly widely used in cases where public institutions are missing, or governance procecesses are underdeveloped or corrupt. For some issues that transcend a single government—such as, regulation of labor practices within the supply chain of multinational companies or climate change—the required cooperation and coordination among governments has been undermined by free-rider problems, the lack of an adequate framework for international law governing multinational corporations, and the inability of existing multilateral organizations to impose sanctions. One such example is the attempt to reduce the availability of "conflict diamonds," which are used to fund civil wars in West Africa.

But private regulation is increasingly common in the countries with well-developed public regulatory capacities. In the U.S., for example, more money is spent on private environmental inspections than Federal enforcement efforts (Vandenbergh 2013). Activists and observers have argued that this shift towards private solutions may reflect the increasing difficulty to adopt new regulations. Vandenbergh (2013) points out that in the U.S. no major environmental statutes has been enacted since the Clean Air Act Amendments in 1990. Michael Brune, long-time executive director of the Rainforest Action Network (RAN) and currently executive director of the Sierra Club, 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).

[1] Maxwell, Lyon, and Hackett (2001) call this "self regulation". Vogel (2010) presents the closely related idea of "civil regulation". Vandenberg (2013) uses the term "private governance".

Rather than engaging through traditional public channels activists have started to target companies directly via corporate campaigns. Such campaigns usually consist of a specific demand, e.g. increase wage rates, accompanied by an implicit or explicit threat to impose harm on the company if management does not comply with the demand (Baron and Diermeier 2007).[2] Such harm can take the form of consumer boycotts, harassment of executives and workers, shareholder resolution, divestment campaigns, and so forth. Though campaigns sometimes involve disruption of operations or boycotts, the most common way that activists seek to harm or reward firms is through the effect of the campaign on the reputation of the target firm. To be successful corporate campaigns need to attract media attention, either through coverage in the news media or by leveraging social media such as Facebook and Twitter. 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.[3]

Private regulation can occur at the level of individual firms at the level of industries or industry segements. After global media outrage over working conditions at its main supplier Foxconn, Apple agreed to significantly improve labor conditions at Chinese factories. This decision followed months of controversy over allegedly illegal overtime, inadequate safety conditions and poor workers' housing, as well as a string of reported suicides. Perhaps even more common is the tacit abandonment of controversial business practices by individual firms. The McDonald's Corp., for example, has modified its business practices in response to activist campaigns and in anticipation of both public and private politics. McDonald's has changed its conduct in the areas such as safety, environmental stewardship, labor conditions at suppliers, animal welfare, the use of antibiotics in food animals, as well as obesity and healthy living (Baron, 2006).

Given the scale of global supply-chains even approaches concentrated on a single firm can have a significant impact. Walmart, for example, has over 10,000 Chinese suppliers and would be China's eighth largest trading partner if it were a country (Vandenbergh 2013). Walmart uses supply-chain contracting on a large scale from labor conditions to energy and emission requirements, packaging, sustainable fisheries, or conflict-free diamonds, to name just a few. Industry surveys show that roughly half to companies surveyed impose environmental requirements on their suppliers that exceed regulatory requirements (Vandenbergh 2007, 2013).

A recent example of industry-wide private regulation was triggered by the collapse of the Rana Plaza factory building in Dhaka, Bangladesh on April 24, 2013. In the accident more than 1000 garment workers, mostly women, died. The Rana Plaza factory was a supplier to many international

[2] Most corporate campaigns tend to rely exlcusively on threatened harm rather than promised rewards (e.g. endorsements). See Baron and Diermeier (2007) for details.

[3] In some cases companies and industries adopt self-regulation to forestall public regulattion (Lyon and Maxwell 2002). Our focus will be on self-regulation to prevent harm from the actions of private agents (activists, NGOs) not public agents (regulators, legislators, courts). For a recent model that studies the interaction between private politics and public regulators see Egorov and Harstad (2012).

retailers and brands including Walmart, Disney, The Gap, and H&M. Global media coverage quickly pointed to lax building construction and safety standards and poor working conditions. After considerable media outrage and activist pressure companies either withdrew from Bangladesh or agreed to improved safety standards.

Private regulation is based on agreements between private parties. In some cases such agreements constitute legally binding contracts. For example, in the wake of the Rana Plaza collapse more than 70 companies, mostly leading European retail brands, established the *Accord on Fire and Building Safety in Bangladesh,* a legally binding agreement to improve working conditions and safety standards among overseas supplier. In other cases, the agreements are not legally binding. U.S. retailers and brands, for example, largely did not join the *Accord*, but joined in a separate agreement, the *Alliance of Bangladesh Worker Safety,* a voluntary agreement without legal force. To be effective agreements that are not legally binding must be self-enforcing, e.g. by the credible activist threat to restart a campaign against a company that fails to comply. Whether agreements are designed to be legally binding or not depends on various factors including different liability exposures and legal traditions (e.g. Kaeb 2008). But whether enshrined in formal contracts or voluntary agreements private governance mechanism in practice "play the standard-setting, implementation, monitoring, enforcement, and adjudication roles traditionally played by public regulatory regimes" (Vandenbergh 2013; p. 105).

Private regulation can have substantial consequences. The 2011 protests over the price of cottage cheese in Israel led to a 20% immediate price reduction that was sustained over a 20 year period (Hendel, Lach, and Spiegel 2013). Similarly, an analysis of Indonesian suppliers in the textile, footwear, apparel sectors showed an 30 percent wage increase for suppliers to major brands such as Nike, Addidas, and Reebok compared to domestic manufacturers in the same sector (Harrison and Scorse 2010).[4] Major brands, especially Nike, had been accused since the 1990s for sweat-shop working conditions at their off-shore suppliers. After a sustained campaign Nike and other retailers committed to codes of conduct for their suppliers and established monitoring programs. Harrison and Scorse (2010) also show that the raise in wages did not lead to increased unemployment, but was effectively redistributive in nature, analogous to forced profit-sharing.

More generally, as the scope of private regulation is growing, scholars have raised concerns whether it is an adequate response to the market and governance failures that can arise in a global economy (e.g. Haufler 2001, Bhagwati and Narlikar 2013). For example, in the context of labor conditions some critics argue that private regulation will undermine the competitiveness of low-cost suppliers and reverse labor force participation for women in traditional societies (e.g. Bhagwati and Narlikar 2013). Others have argued that private regulation may undercut the pressure for public regulation, especially in the context of global environmental concerns such as climate change. Such claims are difficult to assess in the absence of a model. For example, any welfare analysis of private

[4] Indonesian manufacturers in the textile, footwear, apparel sectors also have higher wage ratess, about 10-20%, compared to other manufacturing sectors (Harrison and Scorse 2010).

regulation must be clear about its comparison case. First-best comparisons are often unrealistic since the alternative to private politics is often the complete absence of regulation due to lack of governance capacity or jurisdiction, or a dysfunctional or corrupt political process that is incapable of implementing first-best regulatory solutions.

Our paper explores this question by presenting a theory of corporate campaigns, with a focus on their welfare implications. To the extent that reputation is a valuable asset, the corporate campaign is a potentially powerful incentive mechanism for inducing firms to take socially beneficial actions. If public regulation is weak or non-existent, campaigns may well serve the social interest. On the other hand, the objectives of activists are not necessarily the objectives of society as a whole; for example, activists may be much more passionate about attaining their objective than a welfare-maximizing planner would be. If so, the campaign could be a highly imperfect vehicle for changing the incentives of target firms. Not only would campaigns induce firms to overdirect resources toward addressing problems that activists care passionately about, but the harm that campaigns can do to firms' reputation may have its own cost (e.g., making it more difficult for the firm whose reputation is impaired to recruit talent, have access to capital, or grow its business with significant consequences for its suppliers and business partners). For these reasons, it is an open question to what extent corporate campaigns would be expected to increase social welfare. Indeed, it seems conceivable that they could even decrease welfare, in which case society would be better off without them, even in a context in which there is no viable form of public regulation.

Our theory relies on a three-period game involving a profit-maximizing firm and activist whose objective is to achieve abatement of an unregulated and untaxed social harm that the firm, in the normal course of its operations would not directly internalize. Each period the firm can incur costs to voluntarily abate the social harm (i.e., engage in private regulation) as a way to stochastically improve its reputation, taken here to be the firm's standing among key constituencies including customers, current and prospective employees, opinion leaders, and public authorities. At the same time, the activist can initiate a campaign aimed at undermining the firm's reputation as a way of motivating the firm to increase its abatement effort.[5] The firm's single-period profits are assumed to increase in reputation, but at a diminishing rate, what we call diminishing static returns to reputation. Because reputation enhancement is valuable, the firm would engage in some degree of private regulation even without activist pressure, though its amount would typically be less than the socially efficient level because it does not internalize the social benefit of abatement.

However, faced with a campaign by an activist, the firm not only faces headwinds in its efforts to improve its reputation, it also faces the risk that its reputation could decline. We show that diminishing static returns to reputation "cascades back" to make the firm's (endogenous) value function at the beginning of the second period (which reflects the discounted present value of expected second and third period profit) increase in reputation but at a diminishing rate, what we

[5] Because the game terminates in the third period, the interesting action takes place in the first and second periods. However, the third period matters because the prospect of improving profitabillity in the third period motivates the firm to engage in private regulation in period two.

call diminishing dynamic returns to reputation. With diminishing dynamic returns to reputation, we show that in the initial period—the only point in time at which a campaign will take place in equilibrium—the firm will choose a higher level of private regulation than it would have had there been no pressure from the activist. Private regulation in our model thus stems from two conceptually distinct sources: a baseline level aimed at burnishing reputation, and an additional level (arising when the activist launches a campaign) that serves as insurance against reputation loss by a firm that is (endogenously) risk averse in reputation. In this sense, private regulation in our model reflects two of the drivers identified by Haufler (2001): reputation enhancement and risk management.[6] The first-period campaign itself arises because second-period private regulation decreases in reputation—an implication of diminishing static returns to reputation—and if the firm's reputation is tarnished, it will engage in more abatement activity, which is the activist's objective. If there were constant or increasing static returns to reputation, the interests of the activist and the firm would be aligned, and there would be no campaign.[7]

There are two channels in the model by which an activist campaign could increase the expected present value of social welfare relative to the benchmark in which there is no private regulation (the plausible benchmark in a global setting). First, if private regulation in the initial period is less than the level that maximizes the static net social benefit from abating the social harm, the increase in first-period private regulation engendered by the campaign will work to increase social welfare. Second, as noted, the campaign in the first period makes it possible that the firm's reputation will decline between periods one and two, and it may also make it less likely that the firm's reputation will increase between periods one and two. (This latter effect depends on whether the increased private regulation in period one does not offset the "headwinds" created by the campaign.) By stochastically lowering the firm's second-period reputation, the first-period campaign would stochastically increase the amount of abatement activist in period two. The greater abatement of the social harm works to increase social welfare, but this improvement is offset by the reduction in the discounted present value of the firm's profit and possibly, too, by the reduction in welfare of other constituencies, such as consumers or employees, who derive more value when the firm's reputation is higher rather than lower. The balance of these forces is summarized by a term we call the *social* return to reputation, the extent to which second-period social welfare goes up or down when the firm's reputation increases. When the social return to reputation is negative, the second channel operates to increase social welfare. We show that the social return to reputation is more likely to be negative when the marginal social benefit of abatement activity is high, when the marginal cost of abatement low, when diminishing static returns to reputation are pronounced , and (somewhat surprisingly) the profit increment to reputation is large (for then the diminishing static returns to reputation have greater force). Through as combination of analytical results and numerical examples, we identify circumstances under which these channels operate. Overall, the

[6] The third driver identified by Haufler (2001) is the more rapid spread of best practices for how to voluntarily regulate.

[7] In fact, with increasing static returns to reputation, the activist would want to assist the firm in building its reputation because that would induce the firm to undertake more abatement activity.

presence of the activist may increase or decrease the expected present value of social welfare relative to the no-activist benchmark. The typical case in which the activist plays a constructive role is one in which the marginal benefit of abatement activity is high, the diminishing static returns to reputation are pronounced, and the activist is moderate, i.e. not excessively passionate about the cause of abating the social harm.

Though the primary focus of this paper is on the welfare effects of corporate campaigns and private regulation, the analytical implication of our model conform with some of the stylized facts about activists. For example, in our model, the activist's reaction function—its optimal campaign intensity for any given level of abatement activity by the firm—is decreasing in that abatement activity, which is consistent with the findings in Lenox and Eesley (2009) that environmental activists tend to target firms with higher levels of greenhouse gas emissions. Also, activists tend to target companies for whom reputation is more valuable, e.g. well-known brands (King and McDonnell 2012). Private regulation in both the first and second periods decrease in the firm's reputation, which is in accord with the findings in Kotchen and Moon (2012) that companies known for being socially irresponsible tend to engage subsequently in greater levels of corporate social responsibility than companies that are less irresponsible. As noted above, it is this relationship between reputation and private regulation which motivates the activist to mobilize a campaign in our model.

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 analyzes the equilibrium of the three-period game. Section 4 explores the question of whether the activist's campaign benefits society. Section **??** presents a number of robustness checks and potential extensions of the model. Section 5 summarizes and concludes. Proofs of all propositions and lemmas are in the Appendix.[8]

2 The model

We consider a model with two actors—a firm and an activist group—and two key features. First, the firm's operations contribute to a visible, but unregulated and untaxed, social harm. Second, the extent to which the firm abates the harm—denoted by x— and the intensity of the activist's campaign against the firm—denoted by y—affect the evolution of the firm's reputation for corporate citizenship over time. Reputation for citizenship is *not* a posterior belief about hidden information as in a game theoretic interaction between an informed and uninformed players. Instead, it is a subjective perception held by marketplace actors that may or may not accurately reflect an underlying reality. Reputation for citizenship should be thought of as a dimension of the firm's brand equity. One benefit of a strong reputation for citizenship could be a higher demand for the firm's products. A strong reputation for citizenship could also give the firm an edge in recruiting top executive talent. A strong reputation may also enable the firm to economize on other brand

[8] The proof of Proposition 1 is in the on-line appendix for this paper.

investment activity such as advertising or product promotion, and it may make it easier to find partners for business deals that rely on some degree of trust. Finally, a strong reputation for citizenship might insulate the firm from private legal activity or public regulatory activity.

Throughout the paper, we use the terms "abatement activity" and "private regulation" interchangeably. However, the tangible form of private regulation in practice may be more than just an abatement level. It could involve, among other things, adoption of a code of conduct or a statement of principles focused on the importance of reducing the harm; changes in product packaging or characteristics that are the source of the harm, and changes in management practices aimed auditing and accounting how much harm the firm has actually abated. In short, the firm's abatement effort may be both comprehensive and fairly visible.

2.1 Reputational dynamics

Because reputation is fundamentally a dynamic phenomenon, our model is dynamic. Specifically, the interaction between the activist and the firm is modeled as a dynamic stochastic game that plays out over a finite horizon $t = 1, \ldots, T$, and for simplicity we assume $T = 3$, which (as will be seen below) is the smallest number of periods needed to generate interesting behavior by the activist.

The strength of the firm's reputation is r, where $r \in \mathcal{I} \in \{-\infty, \ldots, 0, 1, \ldots, \infty\}$ is integer valued and is the key state variable in the model. We summarize the impact of reputation on the firm's profitability by a reduced-form profit function $\pi(r)$, where $\pi(\cdot)$ is strictly increasing in r and strictly concave. In what follows, we let $\pi_r = \pi(r)$, and $\Delta\pi_r \equiv \pi_{r+1} - \pi_r$. Thus

$$\pi_{r-1} < \pi_r < \pi_{r+1},$$

$$\Delta\pi_{r-1} > \Delta\pi_r > \Delta\pi_{r+1}.$$

We refer to this latter condition as diminishing *static* returns to reputation (DSRR), "static" because it pertains to the properties of the *single-period* profit function. When DSRR prevails the single-period profit "hit" from reputational loss is more significant than the single-period profit "bump" from reputational improvement. Put another way, to assume DSRR is to assume that the firm is risk averse with respect to its reputation. This strikes us as a plausible assumption. That said, we illustrate below the implications of constant and increasing static returns to reputation.

The profit increment to reputation $\Delta\pi_r$ plays an important role in the analysis. In what follows, it will be useful to parameterize the profit increment as follows:

$$\Delta\pi_r = \theta\Delta\pi_{r-1}, \tag{1}$$

where $\theta \in (0, 1)$ is a parameter indicating the extent of DSRR, or equivalently, the level of reputational risk aversion on the part of the firm: The lower is θ, the more significant is DSRR, and as

$\theta \to 1$, DSRR disappears in the limit.

Reputational dynamics are determined by the following process

$$r_t = r_{t-1} + f_t - a_t,$$

where $f_t \in \{0,1\}$ is a positive shock to the firm's reputation, and $a_t \in \{0,1\}$ is a negative shock to the firm's reputation, where

$$\Pr(f_t = 1) = p(x_t)$$

$$\Pr(a_t = 1) = q(y_t),$$

and $p(0) = 0$, $p'(x) > 0$, $q(0) = 0$, and $q'(x) > 0$. Thus, more private regulation in a given period increases the probability of a positive shock in that period, and greater campaign intensity in that period increases the probability of a negative shock.[9] If a positive and negative shock occur in the same period—$f_t = a_t = 1$—they offset each other, and the firm's reputation remains unchanged.

Because there is a one-to-one relationship between x and p and y and q, respectively, it will be analytically convenient to model the firm and activist as choosing p and q directly. Stretching the terminology slightly, hereafter we refer to p and q as private regulation and campaign intensity, respectively. Letting $h_u(p,q)$, $h_s(p,q)$, and $h_d(p,q)$ denote the probabilities that the firm's reputation increases, stays the same, and decreases from one period to the next, we have:

$$\begin{aligned} h_u(p,q) &= p(1-q) \\ h_d(p,q) &= (1-p)q, \end{aligned}$$

and $h_s(p,q) = 1 - h_u(p,q) - h_d(p,q)$.

2.2 The firm and society

As noted above, the social harm the firm's business operations creates is unregulated. Possible examples include an environmental externality that is not regulated in the parts of the world where the firm operates, the extraction of a "commons" resource by the firm or an upstream supplier in a region where property rights are weak, or unsafe working conditions in an upstream supplier's plant located in a country with little or no occupational safety and health regulation. The private regulation that abates the harm comes at a private cost $c(p)$ to the firm.[10] For simplicity, we assume it is quadratic: $c(p) = \frac{c}{2}p^2$ to the firm. Private regulation is also socially beneficially. The

[9] An alternative formulation would allow for the possibility that current reputational shocks could depend on the entire history of private regulation and campaign intensity, i.e., $\Pr(f_t = 1) = p(x_t, x_{t-1}, \ldots, x_1)$ and $\Pr(a_t = 1) = q(y_t, y_{t-1},, \ldots, y_1)$. This formulation, which includes our setup as a special case, adds notational complexity but relatively little additional insight. For this reason, we focus on the case in which changes in reputation from the current to the next period depend only on current period private regulation and campaign intensity.

[10] Recalling that x is the underlying level of private regulation and $p(x)$ is the probability of a positive shock, $c(p) = C(X(p))$, where $X(p)$ is the inverse of $p(x)$.

social benefit $w(p)$ of the firm's abatement activity is assumed to be entirely external to the firm. The benefit function $w(p) = \omega p$, where $\omega > 0$. For later use, let $p^S = \min\left\{\frac{\omega}{c}, 1\right\} \leq 1$ denote the *static optimum*, the level of private regulation that maximizes the static net benefit $w(p) - c(p)$.

The firm is assumed to maximize discounted expected profits using a discount factor $\beta_F \in (0, 1)$. Because the benefits of private regulation are assumed to be external to the firm, a profit-maximizing firm would have no reason to undertake it unless there was an additional source of private benefit to the firm from doing so. In our model, that benefit comes from the prospect of reputation enhancement and the protection against reputation loss. Of course, reputation management is not the only mechanism that can lead a firm to engage in voluntary private regulation. An alternative benefit of private regulation—studied by Maxwell, Lyon, and Hackett (2000)—is that it can serve as commitment device to make the firm a tougher player in the political lobbying game with proponents of public regulation. Though this is a plausible mechanism in settings with existing (or imminent) public regulation and well-developed institutions of governance, it would not be applicable to settings in which public regulation of the harm caused by the firm does not exist and is unlikely to be adopted in the future. A global company may well find itself in such settings. It might operate in jurisdictions where environmental protection is weak because no single country has taken responsibility for a regional or global pollutant (e.g., carbon emissions). It might rely on a supply chain, some of whose members are located in jurisdictions that effectively have no public regulation of worker safety and health due to poor governance, corruption, or the existence of more pressing development priorities (e.g., the issues brought to light by the 2013 collapse of the Savar garment factory in Bangladesh highlight this possibility). Or the firm may be seen as contributing to a social problem for which there is no public regulation because the solution to the problem does not have an obvious public regulatory remedy, or because resolution of the problem requires multilateral agreements in an environment where such agreement are extremely difficult to achieve (e.g., "conflict diamonds"). In all of these settings, a plausible reason why a firm that is not legally obligated to abate the harm that its actions (or those of its suppliers) cause would nevertheless do so is that it benefits its image among marketplace actors.

2.3 The activist

The activist's campaign is intended to draw public attention to the fact that the firm's business operations create the social harm. It could take the form of boycotts, divestment efforts, or disruption of operations. By choosing a higher level of campaign intensity—which might involve a higher expenditure of resources aimed at organizing volunteers, or spending more resources drawing attention to the campaign so that it is more likely to be covered in the media—the activist increases the likelihood that the firm's reputation will suffer a negative shock. The total cost to the activist of a campaign is given by $\gamma(q) = \frac{\gamma q^2}{2}$, where $\gamma \geq 0$.

We assume that the activist's campaign tactics—boycotts or disruptions of operation—have no direct cost to the firm. These tactics are used only to draw attention to the harm the firm creates in the traditional or social media in the hope of hurting the firm's reputation. We further assume that the activist actually does not derive a *direct benefit* from hurting the firm's reputation. That is, it is no happier when the firm has a lower reputation than it is when the firm has a higher reputation. Instead, we assume that the activist is *pragmatic*. Instead, the activist's only source of benefit is the level of abatement activity the firm provides each period, i.e., its private regulation. We assume the activist maximizes the difference between $\psi w(p)$ and the cost mounting a campaign, where $\psi \geq 1$ is the activist's passion for the "abatement cause." The activist's discount factor is given by $\beta_A > 0$. A campaign benefits a pragmatic activist only if, by causing the firm's reputation to decrease, the firm subsequently decides to increase the level of private regulation. In a sense, then, the activist is akin to a principal in a principal-agent model, but it is a principal whose objective function is not necessarily aligned with social welfare.

2.4 Equilibrium conditions

An equilibrium of our dynamic stochastic game is described by $\{(p_{rt}, q_{rt}, u_{rt}, v_{rt})| \, (r,t) \in \mathcal{I} \times \{1,2,3\}\}$, where u_{rt} and v_{rt} are the firm's and activist's values in state r, period t. These values are described by Bellman equations as follows:

$$u_{rt} = \max_{p_{rt}\in[0,1]} U_{rt}(p_{rt}, q_{rt}) \equiv \pi_r - \frac{cp_{rt}^2}{2} + \beta_F u_{r,t+1} + \beta_F \left\{\Delta u_{r,t+1} h_u(p_{rt}, q_{rt}) - \Delta u_{r-1,t+1} h_d(p_{rt}, q_{rt})\right\}; \tag{2}$$

$$v_{rt} = \max_{q_{rt}\in[0,1]} V_{rt}(p_{rt}, q_{rt}) = \psi w(p_{rt}) - \frac{\gamma q_{rt}^2}{2} + \beta_A v_{r,t+1} + \beta_A \left\{\Delta v_{r,t+1} h_u(p_{rt}, q_{rt}) - \Delta v_{r-1,t+1} h_d(p_{rt}, q_{rt})\right\}, \tag{3}$$

where $\Delta u_{rt} \equiv u_{r+1,t} - u_{rt}$ and $\Delta v_{rt} \equiv v_{r+1,t} - v_{rt}$, and it is understood that $u_{r4} = v_{r4} = 0$.[11] $U_{rt}(p_{rt}, q_{rt})$ and $V_{rt}(p_{rt}, q_{rt})$ are strictly concave in p_{rt} and q_{rt}, respectively, so the Kuhn-Tucker first-order conditions are necessary and sufficient for a unique global optimum. Using the expression for the derivatives of $h_u(p,q)$ and $h_d(p,q)$ those conditions in state (r,t) can be expressed as:

$$-cp_{rt} + \beta_F \left[(1-q)\Delta u_{r,t+1} + q\Delta u_{r-1,t+1}\right] + \varsigma_{rt}^{p0} - \varsigma_{rt}^{p1} = 0; \left\{ \begin{array}{c} p_{rt} \in [0,1] \\ \varsigma_{rt}^{p0} p_{rt} = \varsigma_{rt}^{p1}(1-p_{rt}) = 0 \\ \varsigma_{rt}^{p0} \geq 0; \varsigma_{rt}^{p1} \geq 0 \end{array} \right\}; \tag{4}$$

$$-\gamma q_{rt} + \beta_A \left[\{p\left(-\Delta v_{r,t+1}\right) + (1-p)(-\Delta v_{r-1,t+1})\}\right] + \varsigma_{rt}^{q0} - \varsigma_{rt}^{q1} = 0; \left\{ \begin{array}{c} q_{rt} \in [0,1] \\ \varsigma_{rt}^{q0} q_{rt} = \varsigma_{rt}^{q1}(1-q_{rt}) = 0 \\ \varsigma_{rt}^{q0} \geq 0; \varsigma_{rt}^{q1} \geq 0 \end{array} \right\}. \tag{5}$$

where ς_{rt}^{p1}, ς_{rt}^{p1}, ς_{rt}^{q0}, and ς_{rt}^{q1} are Lagrange multipliers. Hereafter, we let $*$ denote equilibrium values.

Throughout our analysis we maintain we maintain the following assumption:

[11] Note that in writing (2) and (3), we have used $h_s(x,y) = 1 - h_u(x,y) - h_d(x,y)$.

Assumption 1 *For all $r \in \mathcal{I}$, $c > \beta_F(1+\beta_F)\Delta\pi_r$.*

This assumption says that the marginal cost of private regulation at $p = 1$, exceeds the discounted gain from improving reputation. The impact of the assumption is to eliminate equilibria (with our without the activist) which involve corner solutions for private regulation ($p = 1$). Considering corner solutions would not change the results, but it makes notation and verbiage more cumbersome.

3 Equilibrium analysis

We proceed in two steps. We first characterize the no-activist equilibrium—what the firm would optimally do in the absence of an activist. Essentially this involves setting $q = 0$, and analyzing the firm's dynamic programming problem. We then analyze the equilibrium with the activist.

3.1 No activist benchmark

We denote the no-activist benchmark by the superscript "0." We characterize the no-activist benchmark through a series of propositions.

Proposition 1 *In the absence of an activist, the firm's optimal level of private regulation is given by:*[12]

$$p^0_{r3} = 0, \tag{6}$$

$$p^0_{r2} = \frac{\beta_F \Delta\pi_r}{c} \in (0,1), \tag{7}$$

$$p^0_{r1} = \frac{\beta_F \Delta u^0_{r2}}{c} \in (0,1). \tag{8}$$

In period 2, the level of private regulation is decreasing in reputation, i.e.,

$$p^0_{r+1,2} < p^0_{r2}, \tag{9}$$

The value to the firm in the absence of an activist is given by:

$$u^0_{r3} = \pi_r \tag{10}$$

$$u^0_{r2} = (1+\beta_F)\pi_r + \frac{\beta_F^2 (\Delta\pi_r)^2}{2c} \tag{11}$$

$$u^0_{r1} = \pi_r + \beta_F u^0_{r2} - \frac{c}{2}\left(p^0_{r1}\right)^2 + \beta_F p^0_{r1} \Delta u^0_{r2}. \tag{12}$$

These values are strictly increasing in reputation in each period, i.e.,

$$\Delta u^0_{rt} > 0, \; r \in \mathcal{I}, t = 1,2,3. \tag{13}$$

[12] Unless explicitly noted, the results in this and subsequently propositions that are expressed in terms of an arbitrary state r should be thought of as applying to all possible states in $\mathcal{I}$.

The second period value increment is greater the more patient the firm, i.e.,

$$\frac{\partial \Delta u_{r2}^{0}}{\partial \beta_F} > 0, \; r \in \mathcal{I}$$

There is no private regulation in the terminal period, but positive amounts in the penultimate and initial periods. From (9), we see that in the absence of an activist, firm's with stronger reputations undertake less private regulation in period 2. This is because single-period profit is subject to diminishing marginal returns. We now show that the firm's second-period value is also subject to diminishing marginal returns, which in turn implies that the firm's private regulation in the first-period is also weakly decreasing in its reputation. In both the first and second periods, then, a stronger reputation dampens incentives to undertake private regulation.

Proposition 2 *The firm's second-period value function exhibits diminishing marginal returns to reputation, i.e.,* $\Delta u_{r2}^{0} < \Delta u_{r-1,2}^{0}$. *As a consequence, the firm's first-period private regulation is strictly decreasing in its reputation level, i.e.,* $p_{r+1,1}^{0} < p_{r1}^{0}$.

Proposition 2 is an important result for our subsequent analysis. It shows that the *assumed* property of DSRR —which directly shapes the relationship between private regulation and reputation in the penultimate period, 2—*endogenously* "cascades backward" through time to make the firm's value function concave in reputation in period 1. That is, the firm's period-one value function, which presumes optimal behavior in all subsequent periods, inherits the concavity of the static profit function. Reputational risk aversion thus holds dynamically. For this reason, we refer to the result that $\Delta u_{r-1,2}^{0} > \Delta u_{r2}^{0}$ as diminishing *dynamic* returns to reputation (DDRR). With this property, a strong reputation is a deterrent to private regulation, as indicated by the result in Proposition 2 that $p_{r+1,1} < p_{r1}$. As we will see, DDRR plays an important role in our subsequent analysis with an activist. Most significantly, DDRR implies that the firm is risk averse with respect to the loss of reputation in period 1. Given the importance of DDRR, it useful to see how varies with key parameters. From (11) and using (1) we have:

$$\Delta u_{r2}^{0} = \theta \Delta\pi_{r-1} \left\{ (1+\beta_F) - \frac{\theta\left(1-\theta^2\right)\beta_F^2 \Delta\pi_{r-1}}{2c} \right\}$$

$$\Delta u_{r-1,2}^{0} = \Delta\pi_{r-1} \left\{ (1+\beta_F) - \frac{\left(1-\theta^2\right)\beta_F^2 \Delta\pi_{r-1}}{2c} \right\}$$

so

$$\Delta u_{r-1,2}^{0} - \Delta u_{r2}^{0} = \Delta\pi_{r-1} \left\{ (1-\theta)(1+\beta_F) - \frac{\beta_F^2 \Delta\pi_{r-1}\left(1-\theta^2\right)^2}{2c} \right\}$$

Thus

$$\frac{\partial\left[\Delta u_{r-1,2}^{0} - \Delta u_{r2}^{0}\right]}{\partial\theta} = \Delta\pi_{r-1} \left\{ -1 - \beta_F \left[1 - \frac{2\theta(1-\theta^2)\beta_F \Delta\pi_{r-1}}{c} \right] \right\} < 0,$$

where the inequality follows because Assumption 1 implies $\frac{\beta_F \Delta\pi_{r-1}}{c} < 1$ and since $\theta < 1$, $2\theta(1-\theta) \leq \frac{1}{2}$. Thus, the more pronounced is DSRR (lower θ), the more pronounced is DDRR. It is also straightforward to show that

$$\lim_{\theta \to 1} \left[\Delta u^0_{r-1,2} - \Delta u^0_{r2}\right] = 0,$$

so that DSRR is a necessary condition for DDRR.

Differentiating with respect to the discount factor β_F we have

$$\frac{\partial \left[\Delta u^0_{r-1,2} - \Delta u^0_{r2}\right]}{\partial \beta_F} = (1-\theta)\Delta\pi_{r-1}\left\{1 - \frac{\beta_F \Delta\pi_{r-1}(1+\theta)\left(1-\theta^2\right)}{c}\right\}.$$

Given Assumption 1, a sufficient condition for this to be positive is

$$(1+\theta)\left(1-\theta^2\right) < 1 + \beta_F \tag{14}$$

which holds if the firm is sufficiently patient or sufficiently risk averse.[13] Thus, for sufficiently high discount factors and/or high degrees of risk aversion, DDRR becomes more pronounced the more patient the firm is.

We have seen that private regulation with reputation in period 1 and 2. Private regulation also declines over time for a given level of reputation.

Proposition 3 *Private regulation weakly declines over time, i.e., $p^0_{r3} \leq p^0_{r2} \leq p^0_{r1}$. It strictly decreases between periods 1 and 2 if private regulation is positive in period 1.*

Proposition 3 arises because a two-period reputational advantage is more valuable than a single-period reputational advantage, as reflected in the result (obtained in the proof to Proposition 3) that $\Delta u^0_{r2} > \Delta\pi_r$.

An implication of Propositions 1 and 3 is that a firm that succeeds in improving its reputation in the first period will subsequently "coast" on its reputation by reducing the amount of private regulation it engages in the second period.

Proposition 4 *Suppose a firm manages to increase its reputation in period 1. Then the amount of private regulation it engages in period 2 will be strictly less than the amount of private regulation it engaged in period 1, i.e., $p^0_{r+1,2} < p^0_{r1}$.*

Coasting provides a motivation for a "pragmatic" activist to counter the firm's efforts to improve its reputation in period 1.

3.2 The equilibrium with an activist

We now turn to the characterization of the equilibrium with an activist.

[13] In fact, because $\max_{\theta\in(0,1)}(1+\theta)\left(1-\theta^2\right) = 32/27, \beta_F > 5/27 \simeq 0.19$ is sufficient for (14) to hold for all $\theta \in [0,1]$.

3.2.1 Preliminary results

We begin by establishing several results that immediately follow from the finite-horizon structure of the game:

Lemma 1 $p_{r3}^* = q_{r3}^* = q_{r2}^* = 0$, *i.e., in the terminal period the firm does not engage in private regulation (as in the no-activist case), and in neither the terminal period and the penultimate period, the activist does not mount a campaign.*

Because the activist benefits only from a change in the firm's behavior in the subsequent period, and because the firm's behavior (trivially) does not vary in period 3, the activist gains no benefit from a campaign in period 2. By contrast, the firm may want to engage in private regulation in period 2 because the potential improvement in reputation would result in higher profits in period 3.

Lemma 2 *The firm's private regulation in period 2 equals the level in the no-activist case, i.e.,* $p_{r2}^* = p_{r2}^0$.

Lemmas 1 and 2 immediately lead to the following characterization of the equilibrium values for the firm and the activist:

Lemma 3 *The equilibrium values for the firm and the activist in periods 2 and 3 are as follows:*

$$\begin{aligned} u_{r3}^* &= u_{r3}^0 = \pi_r. \\ u_{r2}^* &= u_{r2}^0 = (1+\beta_F)\pi_r + \frac{\beta_F^2 \Delta\pi_r^2}{2c}. \end{aligned}$$

$$\begin{aligned} v_{r3}^* &= 0, \\ v_{r2}^* &= \psi w(p_{r2}^0). \end{aligned}$$

As established in Proposition 1, the firm's value is strictly increasing in reputation level in periods 2 and 3. The activist's value, by contrast, is decreasing in the firm's reputation in period 2, i.e., $\Delta v_{r2}^* < 0$.

The next proposition summarizes a key implication of this result:

Proposition 5 *The interests of the firm and the activist in period 1 are opposed. Because the firm prefers to be in a higher reputation state in period 2 to a lower one, it benefits from actions in period 1 that make an increase in its reputation more likely. Because the activist prefers the firm to be a lower reputation state in period 2 to a higher one, it benefits from actions in period 1 that make an increase in its reputation more likely.*

The activist benefits by weakening the firm's reputation in period 2 because it motivates the firm to undertake a greater level of private regulation in that period. A weaker reputation keeps the firm "hungry" to improve its image. This preference by the activist sets the stage for a corporate campaign in period 1.

3.2.2 First-period equilibrium

We now turn to the first period. Let

$$\Delta w_{r2}^0 \equiv w(p_{r2}^0) - w(p_{r+1,2}^0) = \frac{\omega\beta_F}{c}\left[\Delta\pi_r - \Delta\pi_{r+1}\right] = \frac{\omega\beta_F \Delta\pi_{r-1}}{c}\theta(1-\theta) > 0. \quad (15)$$

$$\Delta w_{r-1,2}^0 \equiv w(p_{r-1,2}^0) - w(p_{r2}^0) = \frac{\omega\beta_F}{c}\left[\Delta\pi_{r-1} - \Delta\pi_r\right] = \frac{\omega\beta_F \Delta\pi_{r-1}}{c}(1-\theta) > 0. \quad (16)$$

As noted in the proof of Lemma 3, $\Delta v_{i2}^* = -\psi\Delta w_{i2}^0 < 0$ for $i = r-1, r$. Thus, $-\Delta v_{i2}^*$ and Δu_{i2}^0 are positive for $i = r-1, r$, and the Kuhn-Tucker conditions in (4)-(5) imply that $\varsigma_{r1}^{p0} = \varsigma_{r1}^{q0} = 0$ and $p_{r1} > 0$ and $q_{r1} > 0$.[14] Moreover, because Assumption 1 implies $\frac{\beta_F \Delta u_{r2}^0}{c} < \frac{\beta_F \Delta u_{r-1,2}^0}{c} < 1, p_{r1} < 1$. Thus, the only possibility for a corner solution is for q to equal 1. From the Kuhn-Tucker conditions, we can therefore derive reaction functions for the firm and activist given by:

$$p_{r1}^{\mathcal{R}}(q) = \frac{\beta_F}{c}\left[\Delta u_{r2}^0 + \left(\Delta u_{r-1,2}^0 - \Delta u_{r2}^0\right)q\right] \quad (17)$$

$$q_{r1}^{\mathcal{R}}(p) = \min\left\{\frac{\beta_A\psi}{\gamma}\left[\Delta w_{r-1,2}^0 - \left(\Delta w_{r-1,2}^0 - \Delta w_{r2}^0\right)p\right], 1\right\}. \quad (18)$$

From (17) and (8), we see that a firm with reputation r follows a simple choice rule: its profit-maximizing private regulation is a convex combination of the no-activist levels of private regulation for reputation levels r and $r-1$. Thus, the greater the campaign intensity the firm expects the activist to undertake, the more private regulation the firm will provide. Moreover, to the extent that $p_{r-1,1}^0$ is large relative to p_{r1}^0 —or equivalently (from (8)) to the extent that $\Delta u_{r-1,2}^0$ is large relative to Δu_{r2}^0—campaign intensity will have a stronger impact on private regulation on the margin. In other words, the activist provides the highest incentives for the firm to engage in private regulation when DDRR is most significant. As shown above, DDRR tends to be large when the firm is patient and when DSRR are pronounced. Thus, patient firms for which the loss of reputation is far more consequential than gains to reputation tend to be most responsive to an activist campaign.

From (15) and (16), we see that $q_{r1}^{\mathcal{R}}(p)$ is decreasing in p. Thus, all things being equal, an activist launches a more intense campaign against a firm that engages in less abatement activity. This is consistent with the empirical evidence in Lenox and Eesley (2009) that environmental activists tend to target firms with higher levels of greenhouse gas emissions.

[14] To see why, suppose to the contrary that $p_{r1} = 0$. The complementary slackness conditions in (4) would then imply $\varsigma_{r1}^{p1} = 0$. The first-order condition in (4) would then reduce to $\beta_F\left[(1-q)\Delta u_{r,t+1} + q\Delta u_{r-1,t+1}\right] + \varsigma_{r1}^{p0} = 0$, a contradiction since $\Delta u_{r2}^0 > 0$, $\Delta u_{r-1,2}^0 > 0$ and $\varsigma_{r1}^{p0} \geq 0$. A similar proof establishes $q_{r1} > 0$.

An immediate implication of (17) and (18) is that the presence of the activist induces the firm to undertake more private regulation in period 1:

Proposition 6 *In the equilibrium with the activist, the firm chooses strictly more private regulation in the face of an activist campaign than in the absence of the activist, i.e.,* $p^*_{r1} > p^0_{r1}$.

The activist makes it more difficult for the firm to improve its reputation between periods 1 and 2, which in isolation acts a force to decrease incentives for private regulation. The activist makes it more difficult for the firm to improve its reputation between periods 1 and 2. In isolation, exogenous changes in factors that make it harder for the firm to improve its reputation would decrease incentives for private regulation. However, the activist also puts the firm at risk of a reputational loss, and given DDRR implied by Proposition 2, the firm gains more by avoiding this downside than it gains by increasing its reputation. Accordingly, the increase in private regulation can be naturally interpreted as self insurance by the firm against the possibility of reputation loss. As noted above, the key to DDRR (and thus Proposition **??**) is DSRR.

The risk aversion of the firm with respect to its reputation that is implied by DSRR is thus the *pragmatic activist's lever.* It is what, ultimately, creates the opposition of interest between the firm and the activist that is the fuel for an activist campaign, and it is what induces the firm to choose a higher level of private regulation in period 1 than it would have in the absence of the activist. This point can be made even more forcefully by considering the implications of constant or increasing returns to reputation, i.e., $\Delta\pi_r \geq \Delta\pi_{r-1}$ for all $r \in \mathcal{I}$. From (7), it follows that p^0_{r2} is constant in r with constant returns to reputation, and p^0_{r2} is increasing in r with increasing returns to reputation. From (15) and (16), we would have $\Delta w^0_{i2} \leq 0$ for $i = r-1, r$, from which it would follow from (5) that $q^{\mathcal{R}}_{r1}(p) = 0$. Indeed, when returns to reputation are increasing, the interests of the firm and the activist are fully aligned. Not only is there no need for the activist to launch a campaign to harm the firm's reputation, it would be counterproductive. If the activist could somehow help the firm improve its reputation, it would do so. This discussion can be summarized by the following proposition:

Proposition 7 *When an activist is pragmatic, a necessary and sufficient condition for the activist to launch a campaign in period 1 is if the firm is risk averse in its reputation, i.e., DSRR holds. If the firm was not risk averse in its reputation, a campaign would be counterproductive for a pragmatic activist, and the activist would even prefer to help the firm build its reputation if static returns to reputation were increasing.*

In light of Proposition **??**, the presence of the activist does two distinct things:

- it increases the level of private regulation in period 1 (a static effect);
- it changes the transition probabilities between reputation states across periods 1 and 2 (a dynamic effect). Specifically, the probability that the firm's reputation improves changes

from $h^0_{ur} \equiv h_u(p^0_{r1}, 0) = p^0_{r1}$ to $h^*_{ur} \equiv h_u(p^*_{r1}, q^*_{r1}) = p^*_{r1}(1 - q^*_{r1})$, and the probability that the firm's reputation declines changes from 0 to $h^*_{dr} \equiv h_d(p^*_{r1}, q^*_{r1}) = (1 - p^*_{r1})q^*_{r1}$.

The dynamic effect could increase or decrease the expected amount of private regulation in period 2 relative to the no-activist case, depending on the interplay of three forces: (i) because the activist's campaign creates a positive probability of reputation loss, it is possible that the firm will end up undertaking the higher level of private regulation associated with the reputation level $r-1$, something that would not have happened without the activist; (ii) the campaign also works to reduce the probability that the firm increases its reputation from r to $r+1$, thus decreasing the chance that the firm will undertake the lower level of private regulation associated with reputation level $r+1$; (iii) the increase in private regulation in period 1 might more than offset this second effect, making it possible that the probability that the firm increases its reputation is actually greater with the activist than without (a "rebound effect"). Overall, the dynamic effect on the expected level private regulation in period 2 is ambiguous, as summarized in the following table, which shows the level of private regulation in state r in period 1 and expected private regulation in periods 2 (viewed from the perspective of period 1, state r). For completeness period 3 is also included:

Period	**No activist**	**Activist**	**Greater under**
1	p^0_{r1}	p^*_{r1}	Activist
2	$(1-h^0_{ur})p^0_{r2} + h^0_{ur}p^0_{r+1,2}$	$p^0_{r,2} + \left\{ \begin{array}{c} -h^*_{ur}\left[p^0_{r2} - p^0_{r+1,2}\right] \\ +h^*_{dr}\left[p^0_{r-1,2} - p^0_{r,2}\right] \end{array} \right\},$	Ambiguous
3	0	0	Same

Rearranging terms from the second row of the table, the presence of the activist unambiguously increases expected private regulation in period 2 if and only if

$$h^*_{ur} - h^0_{ur} < h^*_{dr}\frac{\left[p^0_{r-1,2} - p^0_{r,2}\right]}{\left[p^0_{r2} - p^0_{r+1,2}\right]} \tag{19}$$

For a corner equilibrium in which $q^*_{r1} = 1$, $h^*_{ur} - h^0_{ur} = -p^0_{r1}$, (19) holds, and the activist's presence unambiguously increases expected private regulation. For an interior equilibrium, a sufficient condition for the activist's presence to decrease expected private regulation is that the "rebound effect" does not arise, i.e., $h^*_{ur} - h^0_{ur} < 0$. A sufficient condition for the rebound effect not arising is this:

Proposition 8 *If $\Delta u^0_{r-1,2} - 2\Delta u^0_{r2} < 0$, then $h^*_{ur} - h^0_{ur} < 0$, i.e., the presence of the activist decreases the equilibrium probability that the firm's reputation increases between periods 1 and 2. With no "rebound effect," then the presence of an activist results in a lower probability of reputational improvement between periods 1 and 2 to go along with a (now) positive probability of* *reputational impairment. As a result, when $\Delta u^0_{r-1,2} - 2\Delta u^0_{r2} < 0$, expected period-two reputation must go down and expected period-two private regulation must go up.*

The sufficient condition implies that DSRR is not "too severe," i.e., the firm is not excessively risk averse when it comes to its reputation, and thus the presence of the activist does not "turbocharge" the firm's incentives for private regulation so much that the "rebound effect" arises. If, by contrast, $\Delta u^0_{r-1,2} - 2\Delta u^0_{r2} > 0$, the firm is sufficiently risk averse in reputation that it would "buy" such large amounts of self insurance in the form of private regulation that its probability of reputation improvement actually goes up. This highlights that private regulation as self insurance could have upside private benefits that traditional insurance would not have.

The next proposition fully characterizes the first-period equilibrium:

Proposition 9 *There are two possible equilibrium configurations: a corner equilibrium given by $p^*_{r1} = \frac{\beta_F \Delta u^0_{r-1,2}}{c}$, $q^*_{r1} = 1$ and an interior equilibrium, $p^*_{r1} \in (0,1)$, $q^*_{r1} \in (0,1)$ given by:*

$$p^*_{r1} = \frac{\frac{\beta_F}{c}\left[\left(1 - \frac{\beta_A \psi \Delta w^0_{r-1,2}}{\gamma}\right)\Delta u^0_{r2} + \frac{\beta_A \psi \Delta w^0_{r-1,2}}{\gamma}\Delta u^0_{r-1,2}\right]}{1 + \frac{\beta_F \beta_A \psi}{c\gamma}\left[\Delta u^0_{r-1,2} - \Delta u^0_{r2}\right]\left[\Delta w^0_{r-1,2} - \Delta w^0_{r2}\right]} \tag{20}$$

$$q^*_{r1} = \frac{\frac{\beta_A \psi}{\gamma}\left[\left(1 - \frac{\beta_F \Delta u^0_{r2}}{c}\right)\Delta w^0_{r-1,2} + \frac{\beta_F \Delta u^0_{r2}}{c}\Delta w^0_{r2}\right]}{1 + \frac{\beta_F \beta_A \psi}{c\gamma}\left[\Delta u^0_{r-1,2} - \Delta u^0_{r2}\right]\left[\Delta w^0_{r-1,2} - \Delta w^0_{r2}\right]}. \tag{21}$$

The corner equilibrium arises if and only if

$$\frac{\beta_A \psi}{\gamma}\left[\Delta w^0_{r-1,2}\left(1 - \frac{\beta_F \Delta u^0_{r-1,2}}{c}\right) + \Delta w^0_{r2}\frac{\beta_F \Delta u^0_{r-1,2}}{c}\right] \geq 1. \tag{22}$$

Condition (22), which can be rewritten

$$(1-\theta)\frac{\omega \beta_A \psi}{\gamma}\frac{\beta_F \Delta \pi_{r-1}}{c}\left[\left(1 - \frac{\beta_F \Delta u^0_{r-1,2}}{c}\right) + \theta \frac{\beta_F \Delta u^0_{r-1,2}}{c}\right] \geq 1$$

will hold only if the activist is sufficiently patient, passionate, or cost efficient, or if the social benefit ω of private regulation is sufficiently large.

Figure 1 shows the first-period equilibrium for the case in which (22) does not hold. The firm's reaction function is upward sloping, and the activist's reaction function is downward sloping.

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Figure 2 illustrates what happens when a parameter that enters the activist's reaction function, but not the firm's, changes. (The figure shows the case of a change in the activist's passion ψ). Any factor that shifts the activist's reaction function upward (downward) results in an equilibrium with a higher (lower) level of private regulation and a more (less) intense campaign by the activist in period 1, and any factor that shifts the activist's reaction function downward without affecting

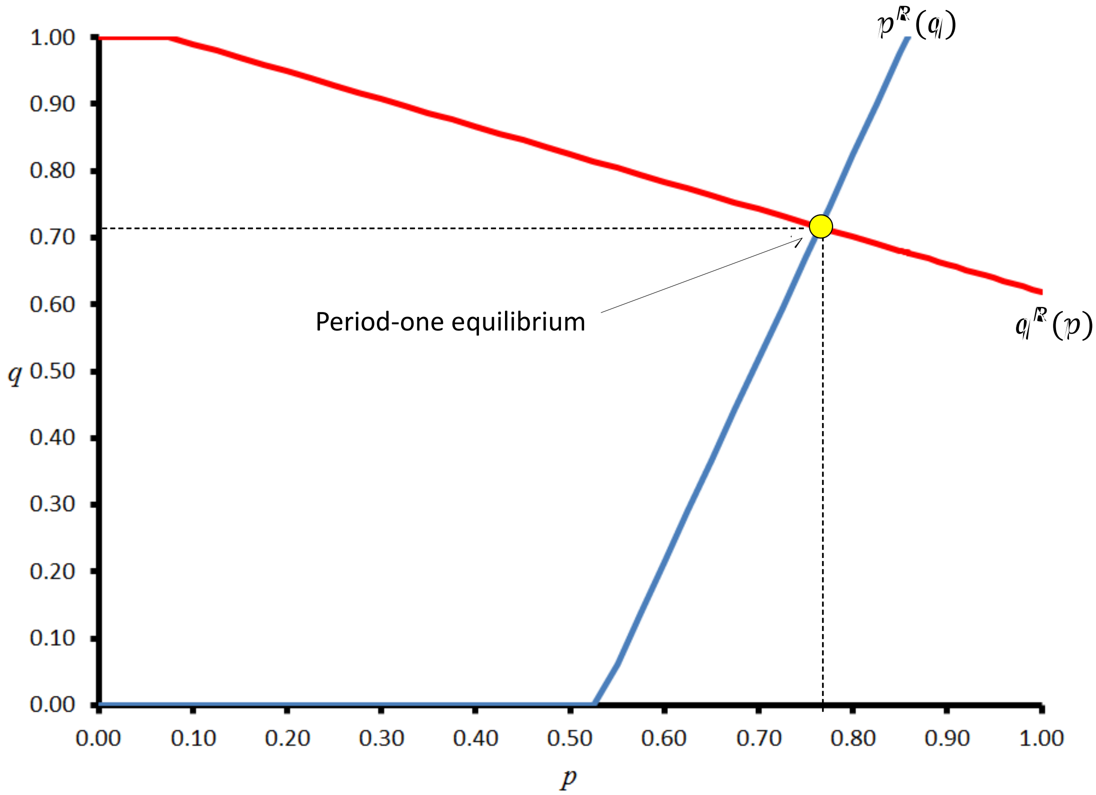

Figure 1: Firm and activist reaction functions and first-period equilibriumFirm and activist reaction functions and first-period equilibrium

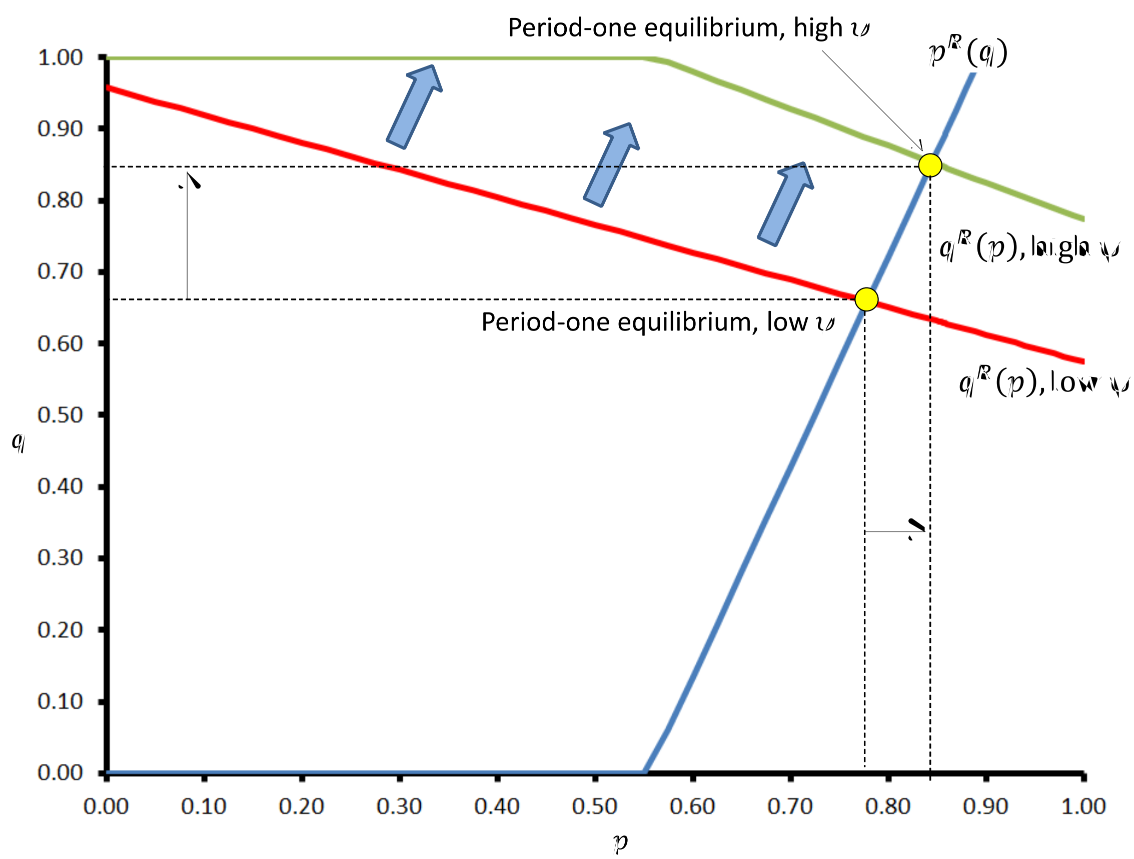

Figure 2: Change in the period-one equilibrium due to a shift in the activist's reaction function.

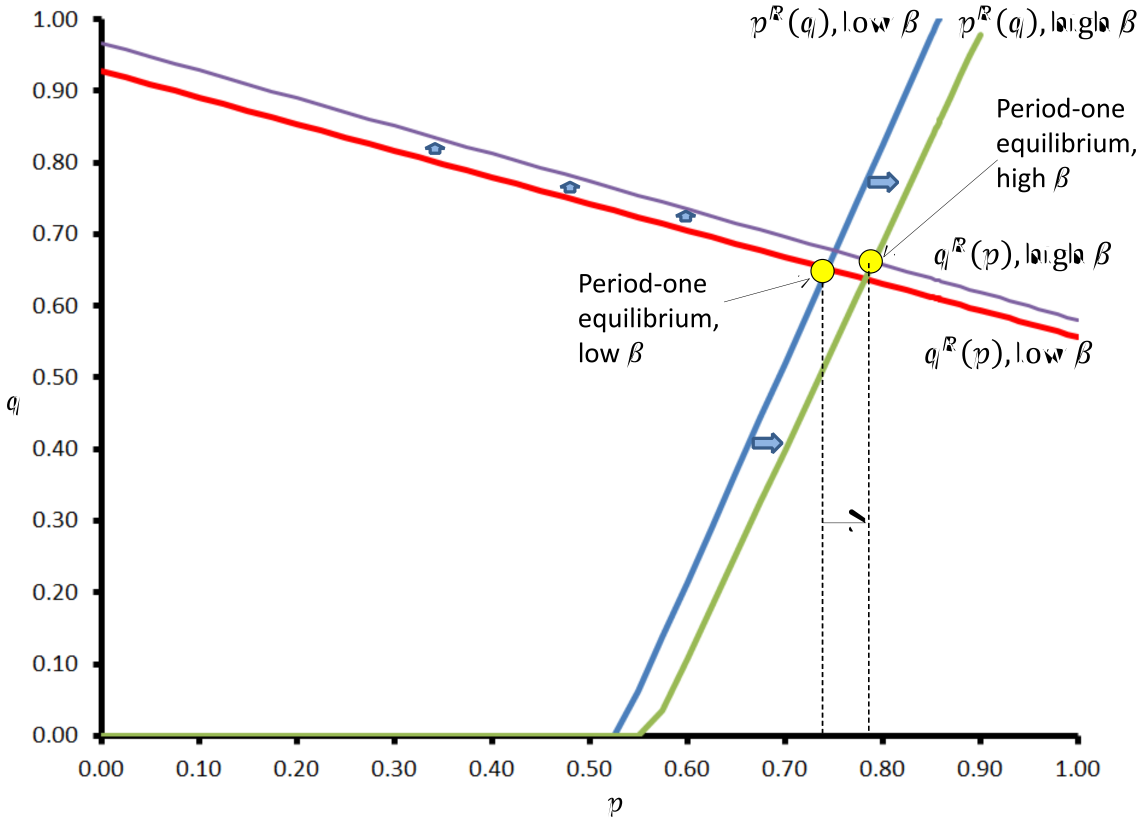

Figure 3: Change in the period-one equilibrium when the firm's reaction function shifts rightward and the activist's reaction function shifts leftward.

the firm's reaction function results in an equilibrium with less private regulation and less intense campaign activity.[15] From (18), it is straightforward to establish that $\frac{\partial q^{\mathcal{R}}_{r1}(p)}{\partial \psi} > 0$, $\frac{\partial q^{\mathcal{R}}_{r1}(p)}{\partial \beta_A} > 0$, $\frac{\partial q^{\mathcal{R}}_{r1}(p)}{\partial \omega} > 0$, and $\frac{\partial q^{\mathcal{R}}_{r1}(p)}{\partial \gamma} < 0$. Further, these parameters do not affect $p^{\mathcal{R}}_{r1}(q)$. Thus:

Proposition 10 *The more passionate the activist (higher ψ), the more patient the activist (higher β_A), the more cost efficient the activist (lower γ), and the higher the social marginal benefit (higher ω), the greater the level of equilibrium private regulation and campaign intensity in period 1.*[16] *For sufficiently high values of ψ, β_A, and ω and/or a sufficiently low value of γ, an increase in any of these parameters will reduce the likelihood that the firm is able to increase its reputation.*

This suggests that patient, passionate, cost-efficient activists are a dangerous adversary for the firm and succeed in getting the firm to increases its private regulation.

Figure 3 shows what happens for a change in a parameter that simultaneously shifts the firm's reaction function rightward and the activist's reaction function upward. Equilibrium private regu-

[15] For the case in which $\Delta w^0_{r2} < \Delta w^0_{r-1,2}$ in which the activist's reaction function is upward sloping, this assumes that the "stability condition"

$$\frac{\beta_A \psi}{\gamma}\left[\Delta w^0_{r2} - \Delta w^0_{r-1,2}\right] < \frac{\beta_F}{c}\left[\Delta u^0_{r2} - \Delta u^0_{r-1,2}\right]$$

holds.

[16] This proposition can also be verified by straightforward (and tedious) differentiation of (**??**) and (**??**).

lation must increase, though the impact on equilibrium campaign intensity is ambiguous because the activist's reaction function is downward sloping and more private regulation would work to decrease campaign intensity. As shown above, $\frac{\partial \Delta u^0_{r2}}{\partial \beta_F} > 0$ for $s = r, r-1$, which from (17) implies $\frac{\partial p^{\mathcal{R}}_{r1}(q)}{\partial \beta_F} > 0$. From (15) and (16), $\frac{\partial \Delta w^0_{s2}}{\partial \beta_F} > 0$ for $s = r, r-1$,which implies $\frac{\partial q^{\mathcal{R}}_{r1}(p)}{\partial \beta_F} > 0$. In addition, it can be shown that $\frac{\partial \left(\frac{\beta_F \Delta u^0_{s2}(c)}{c} \right)}{\partial c} < 0$ for $s = r, r-1$, and from (15) and (16), $\frac{\partial \Delta w^0_{s2}}{\partial c} < 0$ for $s = r, r-1$.[17] This establishes:

Proposition 11 *The more patient the firm (higher β_F) and the rate at which the marginal cost of private regulation increases (lower c), the greater the level of equilibrium private regulation in period 1.*

Using similar reasoning, we can also characterize how the first-period equilibrium depends on reputation.

Proposition 12 *In the first-period equilibrium, the weaker the firm's reputation, the greater its private regulation, i.e., $p^*_{r-1,1} > p^*_{r1}$.*

Proposition 12, together with Lemma 2 and Proposition 1, implies that firms with weaker reputations will undertake more private regulation. This result is consistent with the empirical evidence in Kotchen and Moon (2011) that companies with a reputation for social irresponsibility tend to engage in greater levels of corporate social responsibility than companies that are known for being less irresponsible.

3.2.3 Private regulation dynamics and the distinct roles of private regulation

We have already offered some insight into reputational dynamics implied by the presence of the activist. If DSRR are not too severe, or if the activist is sufficiently passionate, patient, or cost efficient, or if marginal social benefit is sufficiently high, $h^*_{ur} - h^0_{ur} < 0$. Given this and $h^*_{dr} > 0$, the presence of the activist effectively shifts the second-period distribution of r downward, lowering expected reputation and increasing expected private regulation in the second period (and the third period as well).

Another way to think about the dynamics of the model, though, to consider the observed transition of private regulation between periods 1 and 2. Specifically, what happens in the wake of a campaign in period 1 that harms the firm's reputation? Does the firm engage in more private regulation, i.e., $p^*_{r-1,2} = p^0_{r-1,2} > p^*_{r1}$? Based on Proposition 4, one might expect the answer is yes. However, the firm's incentives are more complex and involve three considerations:

[17] Using (44),

$$\frac{\partial \left(\frac{\beta_F \Delta u^0_{s2}}{c} \right)}{\partial c} = -\frac{\beta_F}{c^2} \Delta \pi_r - \frac{\beta_F^3}{c^3} (\Delta \pi_{r+1})^2 - \frac{\beta_F^2}{c^2} \left[1 - \frac{\beta_F \Delta \pi_r}{c} \right] \Delta \pi_r < 0$$

because $1 - \frac{\beta_F \Delta \pi_r}{c} < 0$ due to Assumption 1.

1. As shown in Proposition 3, holding the reputation level fixed, private regulation decreases from period 1 to period 2 because a two-period reputational advantage is more valuable than a one-period reputational advantage. This works to make $p^*_{r-1,2} < p^*_{r1}$.

2. As shown in Proposition 1, second-period private regulation diminishes with reputation. This works to make $p^*_{r-1,2} > p^*_{r1}$.

3. As shown in Proposition **??**, when the activist undertakes a campaign, it boosts the firm's incentives for private regulation in the first period, working to make $p^*_{r-1,2} < p^*_{r1}$.

While the first factor is an artifact of the three-period model, the second and third factors would operate even in an infinite-horizon model. The trade-off reflects the two distinct roles that private regulation plays in our model: reputation building and insurance.[18] Diminishing returns to reputation would tend to make a firm whose reputation is hurt increase its private regulation in an effort to rebuild its reputation. But the *ex ante* "insurance" the firm bought before the campaign took the form of higher private regulation, and once the threat of a campaign goes away, the firm can cut back on its private regulation *ex post*.

On the other hand, if the firm's reputation improves or stays the same between periods 1 and 2, its private regulation in period 2 will decrease, just as in the no-activist case: $p^*_{r+1,2} = p^0_{r+1,2} < p^0_{r2} = p^*_{r2} < p^*_{r1}$. The observable events, then, would be an unsuccessful campaign in period 1, followed in period 2 by an end of the campaign and a decrease in private regulation.

3.2.4 Will the activist "enter the fray"?

The analysis so far has assumed that the activist will contend with the firm in the private regulation game we have analyzed. But it is conceivable that the activist could be better off by simply accepting the level of private regulation the firm provides in the absence of the activist. By doing so, it would avoid the cost of the campaign. More subtly, it would avoid triggering the "rebound effect" whereby the firm, by undertaking more private regulation in period 1, increases the likelihood that its reputation will increase between periods 1 and 2, reducing private regulation in period 2. We thus explore when it is in the activist's interest to "stay on the sidelines" or "enter the fray."

The activist's discounted utility if it enters the fray (hereafter "enters") is given by:

$$v^*_{r1} = \psi w(p^*_{r1}) + \beta_A \psi w(p^0_{r2}) - \beta_A h^*_{ur} \psi \Delta w^0_{r2} + \beta_A h^*_{dr} \psi \Delta w^0_{r-1,2} - \frac{\gamma \left(q^*_{r1}\right)^2}{2}$$

If the activist does not enter, its utility is:

$$v^0_{r1} = \psi w(p^0_{r1}) + \beta_A \psi w(p^0_{r2}) - \beta_A p^0_{r1} \psi \Delta w^0_{r2}.$$

[18] Haufler (2001) makes a similar distinction in her explanation of the emergence of private regulation by global companies.

The difference in the activist's utility is given by $\Delta V_{r0}^{*} = v_{r1}^{*} - v_{r1}^{0}$, or

$$\Delta V_{r0}^{*} = \psi \left[w(p_{r1}^{*}) - w(p_{r1}^{0}) \right] + \beta_A p_{r1}^{0} \psi \Delta w_{r2}^{0} - \beta_A h_{ur}^{*} \psi \Delta w_{r2}^{0} + \beta_A h_{dr}^{*} \psi \Delta w_{r-1,2}^{0} - \frac{\gamma \left(q_{r1}^{*}\right)^2}{2}.$$

We now establish that the activist will indeed enter the fray.

Proposition 13 $\Delta V_{r0}^{*} > 0$, *the activist is strictly better off by entering the fray and launching a campaign against the firm.*

4 Do activist campaigns benefit society?

Are activist campaigns beneficial for society? Because we have assumed throughout that public regulation is either absent or ineffective, in the absence of activist campaign, the only force pushing the firm to engage in abatement activity is reputation-enhancing value. Our benchmark, then is the no-activist equilibrium, and we evaluate the extent to which the presence of the activist increases or decreases welfare relative to this equilibrium.

4.1 The impact of the activist on discounted social welfare

We evaluate the welfare effect of the activist using discounted expected social welfare, evaluated in period 1 for an arbitrary starting reputation state r. Though this is not the only possible metric, it is both comprehensive and natural. Later we consider the activist's impact on narrower welfare metrics.

Per-period social welfare is defined to the discounted value of ωp plus the discounted value of firm profit minus (if relevant) the cost of the activist campaign, plus any *additional* per period surplus that varies with the firm's reputation that the firm does not internalize. For example, if the channel by which reputation increases profits is to increase demand for the firm's products, σ_r would be the consumer surplus from those products, taking into account the price the firm is able to charge because of its reputation. In theory, $\Delta\sigma_r \equiv \sigma_{r+1} - \sigma_r$ could be positive or negative: on the one hand, consumers may receive additional value by consuming products supplied by a firm with a stronger reputation for citizenship, but on the other hand, if the firm has market power, it can raise its price which would offset this additional value. But in the case of a single-product firm, there is a plausible condition—tantamount to the condition that a monopolist supplies less citizenship value to consumers that a welfare-maximizing social planner would—under which the former effect dominates the latter effect.[19] We thus assume that $\Delta\sigma_r > 0$, and in the analysis below, we parameterize this non-internalized reputational spillover by assuming $\Delta\sigma_r = \eta\Delta\pi_r$ where $\eta \geq 0$.

[19] This condition is equivalent to condition that the firm "undersupplies' citizenship value to consumers. More specifically, it is that the value of an increase in reputation to the marginal consumer is less than the average value of an increase in reputation to the average consumer. See Tirole (1988), pp. 100-101 for details.This condition holds, for example, in a model in which increases in r shift a linear demand curve in a parallel fashion.

Throughout the remainder of the analysis, we refer to σ_r as consumer surplus. To simplify notation without significant loss of insight, we assume that the social discount factor and the discount factor on consumer surplus equals the firm's discount factor.

To begin the analysis, we note that because the firm does not internalize the social benefit of abatement or the benefits of reputation building on consumer surplus, the no-activist equilibrium does not maximize social welfare.[20]

Proposition 14 *Let p^F_{rt} be the first-best level of abatement chosen by a welfare-maximizing planner that internalizes the social benefits to abatement and the reputational spillover. For $t = 2, 3$, $p^F_{rt} > p^0_{rt}$ i.e., the planner chooses strictly more abatement than the firm chooses in the absence of the activist. For $t = 1$, unless the reputational spillover is large (specifically, unless $\eta \geq \frac{1}{\beta_F[p^0_{r2} - p^0_{r+1,2}]}$), $p^F_{r1} > p^0_{rt}$, the planner chooses strictly more abatement in period 1 than arises in the absence of the activist.*[21]

This result opens the door to the possibility that the activist's presence could increase social welfare. However, this is not a "sure thing." For one thing, while the no-activist private regulation is less than the socially efficient level of abatement in periods 2 and 3 (in period 3, there is a classic textbook negative externality problem, which cascades back to period 2), the presence of the activist does not change private regulation in these periods. In period 1, the activist will (except when η is extremely large) push the firm in the right direction, but it does so by creating the risk that the firm's reputation will fall between period 1 and 2, something a benevolent planner would not do.[22] The upshot is that to discern the welfare impact of an activist campaign, we must directly compare one distorted equilibrium to another distorted equilibrium.

4.1.1 Present value of social welfare in the absence of an activist

Recalling that u^0_{r1} is the firm's discounted profit and $h^0_{ur} = p^0_{r1}$ is the probability the firm improves its reputation, the discounted present value of social welfare W^0_{r1} in the absence of the activist is

$$W^0_{r1} = u^0_{r1} + \left\{\sigma_r + \beta_F s^0_{r2} + h^0_{ur}\beta_F \Delta s^0_{r2}\right\} + \left\{w(p^0_{r1}) + \beta_F w(p^0_{r2}) - h^0_{ur}\beta_F \Delta w^0_{r2}\right\} \tag{23}$$

[20] In the Appendix, we characterize the first-best social welfare maximization problem, and we prove this proposition there.

[21] To explain why it is possible that $p^F_{r1} < p^0_{r1}$, we note that when $p^F_{r1} < 1$, p^F_{r1} is an increasing function of the change ΔW^F_{r2} in the second-period value function in state r, while (recall) p^F_{r1} is proportional to Δu^0_{r2}. The second-period value function, in turn, depends on a weighted sum of the changes $\Delta W^F_{r3} = \Delta\pi_r + \Delta\sigma_r$ and $\Delta W^F_{r+1,2} = \Delta\pi_{r+1} + \Delta\sigma_{r+1}$ where the weight on the smaller of these changes, $\Delta W^F_{r+1,2}$, is increasing in $\Delta\sigma_r +$ $\Delta\sigma_{r+1}$. If η is large enough, it is possible that Δu^0_{r2} could exceed ΔW^F_{r2} by just enough so that $p^0_{r1} > p^0_{r1}$. What happens in this case is that with a high enough value of η (or equivalently a high $\Delta\sigma_r$) makes the social planner's value function in periods 3 and 2 flatter than the firm's value function.

[22] A planner would directly control abatement to maximize welfare and would not (as we show in the analysis of the first-best problem in the Appendix) choose positive levels of q.

where u^0_{r1} is given by (12), Δw^0_{r2} is given by (15),

$$s^0_{r2} \equiv \sigma_r + \beta_F \sigma_r + p^0_{r2} \beta_F \Delta\sigma_r, \tag{24}$$

and (using the expression for p^0_{2r}),

$$\Delta s^0_{r2} = s^0_{r+1,2} - s^0_{r2} = (1+\beta_F)\Delta\sigma_r + \frac{\beta_F^2}{c}\left[\Delta\sigma_{r+1}\Delta\pi_{r+1} - \Delta\sigma_r\Delta\pi_r\right]. \tag{25}$$

The expression for discounted welfare in (23) thus has three collections of terms: discounted firm profit (the first term), discounted consumer surplus (in the first curly bracket), and the discounted social benefit from abatement activity (the second curly bracket). Substituting (12) into (23) and rearranging terms gives us:

$$\begin{aligned} W^0_{r1} &= \pi_r + \sigma_r + w(p^0_{r1}) - \frac{c}{2}\left(p^0_{r1}\right)^2 + \beta_F\left[u^0_{r2} + s^0_{r2} + w(p^0_{r2})\right] \\ &\quad + h^0_{ur}\beta_F\left[\Delta u^0_{r2} + \Delta s^0_{r2} - \Delta w^0_{r2}\right] \end{aligned} \tag{26}$$

4.1.2 Present value of social welfare in the presence of an activist

Discounted W^*_{r1} welfare in the presence of an activist is in manner similar to W^0_{r1}, but taking into the possibility that the firm's reputation can decline between periods 1 and 2 and recognizing that an activist campaign is costly:

$$\begin{aligned} W^*_{r1} &= u^*_{r1} + \left\{\sigma_r + \beta_F s^0_{r2} + h^*_{ur}\beta_F \Delta s^0_{r2} - h^*_{dr}\beta_F\Delta s^0_{r-1,2}\right\} \\ &\quad + \left\{w(p^*_{r1}) + \beta_F w(p^0_{r2}) - h^*_{ur}\beta_F\Delta w^0_{r2} + h^*_{dr}\beta_F\Delta w^0_{r-1,2}\right\} - \frac{\gamma\left(q^*_{r1}\right)^2}{2} \end{aligned} \tag{27}$$

where

$$u^*_{r1} = \pi_r - \frac{c}{2}\left(p^*_{r1}\right)^2 + \beta_F u^0_{r2} + h^*_{ur}\beta_F\Delta u^0_{r2} - h^*_{dr}\beta_F\Delta u^0_{r-1,2}. \tag{28}$$

In writing (27), we recall that in the equilibrium with an activist, the only period in which outcomes change is period 1 (which, as we have seen, can change the probability distribution over possible reputation levels in period 2). Substituting (28) into (27) gives us:

$$\begin{aligned} W^*_{r1} &= \pi_r + \sigma_r + w(p^*_{r1}) - \frac{c}{2}\left(p^*_{r1}\right)^2 + \beta_F\left[u^0_{r2} + s^0_{r2} + w(p^0_{r2})\right] \\ &\quad + h^*_{ur}\beta_F\left[\Delta u^0_{r2} + \Delta s^0_{r2} - \Delta w^0_{r2}\right] - h^*_{dr}\beta_F\left[\Delta u^0_{r-1,2} + \Delta s^0_{r-1,2} - \Delta w^0_{r-1,2}\right] - \frac{\gamma\left(q^*_{r1}\right)^2}{2} \end{aligned} \tag{29}$$

4.1.3 Comparing social welfare

Taking the difference between (26) and (29), we get

$$\Delta W_r^{*0} \equiv W_{r1}^* - W_{r1}^0 = \left\{ \begin{array}{c} \left\{ \left[w(p_{r1}^*) - \frac{c}{2}\left(p_{r1}^*\right)^2 \right] - \left[w(p_{r1}^0) - \frac{c}{2}\left(p_{r1}^0\right)^2 \right] \right\} \\ + \left[h_{ur}^* - h_{ur}^0 \right] \beta_F \Theta_{r2}^0 - h_{dr}^* \beta_F \Theta_{r-1,2}^0 \\ -\frac{\gamma\left(q_{r1}^*\right)^2}{2}, \end{array} \right\} \tag{30}$$

where

$$\begin{aligned} \Theta_{r2}^0 &\equiv \Delta u_{r2}^0 + \Delta s_{r2}^0 - \Delta w_{r2}^0 \\ \Theta_{r-1,2}^0 &\equiv \Delta u_{r-1,2}^0 + \Delta s_{r-1,2}^0 - \Delta w_{r-1,2}^0 \end{aligned}$$

This expression brings into focus the welfare effects of the activist:

- By increasing private regulation in the first period, the presence of the activist changes first-period welfare by $\left[w(p_{r1}^*) - \frac{c}{2}\left(p_{r1}^*\right)^2 \right] - \left[w(p_{r1}^0) - \frac{c}{2}\left(p_{r1}^0\right)^2 \right]$.
- The activist may change the likelihood that the firm's reputation goes up between the first and second periods, the welfare effect of which in the second period is Θ_{r2}^0.
- The activist introduces a probability that the firm's reputation can decline between the first and second periods, the welfare effect of which in the second period is $\Theta_{r-1,2}^0$.
- The activist incurs a cost of a campaign equal to $-\frac{\gamma\left(q_{r1}^*\right)^2}{2}$.

The terms Θ_{r2}^0 and $\Theta_{r-1,2}^0$ play a key role in the welfare analysis: they are the net social benefit from an increase in the firm's reputation between period 1 and 2 from r to $r+1$ and $r-1$ to r. We call them the *social return to corporate reputation.* The components of Θ_{i2}^0, $i = r, r-1$, are:

- $\Delta u_{i2}^0 > 0$: the private benefit to the firm from a stronger reputation in period 2.;
- Δs_{i2}^0: the increment to consumer surplus when the firm increases its reputation. If $\sigma_{r+1} > \sigma_r$ for all r, $\Delta s_{r2}^0 > 0$; if $\sigma_{r+1} \leq \sigma_r$, $\Delta s_{r2}^0 \leq 0$. As noted, either case is possible, depending on the nature of the demand curves for the firm's products and extent to which the firm exploits a stronger reputation through higher prices;
- $\Delta w_{i2}^0 = w(p_{i2}^0) - w(p_{i+1,2}^0) = \omega \left[p_{i2}^0 - p_{i+1,2}^0 \right] > 0$ is the social *cost* of an improvement in the firm's reputation due to the *lower* level of private regulation the firm undertakes when its reputation increases.

The first two components are direct effects of reputation on welfare; the third component embodies the incentive effect of reputation on private regulation. Using (44), (15), and (25), the social return to corporate reputation is given by:

$$\Theta^0_{r2} = \theta\Delta\pi_{r-1}\left\{(1+\beta_F)(1+\eta) - \frac{(\frac{1}{2}+\eta)\beta_F^2\theta\Delta\pi_{r-1}}{c}\left[1-\theta^2\right] - \frac{\omega\beta_F}{c}\left[1-\theta\right]\right\} \quad (31)$$

$$\Theta^0_{r-1,2} = \Delta\pi_{r-1}\left\{(1+\beta_F)(1+\eta) - \frac{\left(\frac{1}{2}+\eta\right)\beta_F^2\Delta\pi_{r-1}}{c}\left[1-\theta^2\right] - \frac{\omega\beta_F}{c}\left[1-\theta\right]\right\}, \quad (32)$$

where in writing these, we use $\Delta\pi_r = \theta\Delta\pi_{r-1}$ (where recall $\theta < 1$), $\Delta\pi_{r+1} = \theta^2\Delta\pi_{r-1}$, $\Delta\sigma_{r-1} = \eta\Delta\pi_{r-1}$, and $\Delta\sigma_r = \eta\Delta\pi_r$. It can shown that if $\Theta^0_{r-1,2} > 0$,then $\Theta^0_{r,2} > 0$, and the contrapositive, $\Theta^0_{r2} < 0$ implies $\Theta^0_{r-1,2} < 0$.

Rearranging these expressions, we see that the social return to corporate reputation in states r and $r-1$ is negative if and only if:

$$\omega > \frac{(1+\beta_F)(1+\eta)c}{\beta_F(1-\theta)} - (\frac{1}{2}+\eta)(1+\theta)\beta_F\theta\Delta\pi_{r-1} \equiv \Gamma(\beta_F,\eta,c,\theta,\Delta\pi_{r-1}). \quad (33)$$

We refer to this condition as *major harm* because it holds when the marginal social benefit of abatement, ω, is larger than the threshold $\Gamma(\beta_F,\eta,c,\theta,\Delta\pi_{r-1})$. It is straightforward to show that $\frac{\partial\Gamma}{\partial c} > 0$, $\frac{\partial\Gamma}{\partial\eta} > 0$, $\frac{\partial\Gamma}{\partial\Delta\pi_{r-1}} < 0$, and $\frac{\partial\Gamma}{\partial\theta} > 0$.[23] Thus, we have:

Lemma 4 *The social returns to corporate reputation are more likely to be negative (positive) when (i) the marginal social benefit of abatement ω is large (small); (ii) the slope c of the marginal cost function for private regulation is small (large); (ii) the impact η on consumer surplus from an*

[23] To evaluate $\frac{\partial\Gamma}{\partial\eta}$, we have:

$$\frac{\partial\Gamma}{\partial\eta} = \frac{(1+\beta_F)c}{\beta_F(1-\theta)} - (1+\theta)\beta_F\theta\Delta\pi_{r-1} = \frac{c}{(1-\theta)}\left[\frac{(1+\beta_F)}{\beta_F} - \left(1-\theta^2\right)\theta\frac{\beta_F\Delta\pi_{r-1}}{c}\right].$$

Because $\frac{\beta_F\Delta\pi_{r-1}}{c} < 0, \theta < 1$, and $\frac{(1+\beta_F)}{\beta_F} > 1$, this expression is positive.
To evaluate $\frac{\partial\Gamma}{\partial\theta}$, we have:

$$\begin{aligned}
\frac{\partial\Gamma}{\partial\theta} &= \frac{(1+\beta_F)(1+\eta)c}{\beta_F(1-\theta)^2} - (\frac{1}{2}+\eta)(1+2\theta)\beta_F\Delta\pi_{r-1} \\
&= \frac{c}{(1-\theta)^2}\left[\frac{(1+\beta_F)(1+\eta)}{\beta_F} - (\frac{1}{2}+\eta)(1+2\theta)(1-\theta)^2\frac{\beta_F\Delta\pi_{r-1}}{c}\right] \\
&> \frac{c}{(1-\theta)^2}\left[\frac{(1+\beta_F)(1+\eta)}{\beta_F} - (1+\eta)(1+2\theta)(1-\theta)^2\frac{\beta_F\Delta\pi_{r-1}}{c}\right] \\
&= \frac{(1+\eta)c}{(1-\theta)^2}\left[\frac{(1+\beta_F)}{\beta_F} - (1+2\theta)(1-\theta)^2\frac{\beta_F\Delta\pi_{r-1}}{c}\right] \\
&> 0
\end{aligned}$$

Now the function $(1+2\theta)(1-\theta)^2$ takes on a value of 1 at $\theta = 0$ and 0 at $\theta = 1$. Moreover, its derivative is $2(1-\theta)^2 - 2(1+2\theta)(1-\theta) = 2(1-\theta)[(1-\theta)-(1+2\theta)] = -6\theta(1-\theta) < 0$. Thus $(1+2\theta)(1-\theta) < 1$. Since $\frac{\beta_F\Delta\pi_{r-1}}{c} < 1$ as well, the result follows.

increase in corporate reputation is small (large); (iv) the profit increment $\Delta\pi_{r-1}$ to reputation is large (small); (v) DSRR is significant (insignificant), i.e., θ is small (large).

Conditions (i)-(iii) are intuitive. Condition (iv) is a reflection of DDRR. Specifically, from (44), the private benefits to reputation Δu^0_{r2} and $\Delta u^0_{r-1,2}$ are pulled down by $(\Delta\pi_{r+1})^2 - (\Delta\pi_r)^2$ and $(\Delta\pi_r)^2 - (\Delta\pi_{r-1})^2$, respectively. These differences—a component of DDRR—are magnified when the profit difference $\Delta\pi_{r-1}$ is large (because then $\Delta\pi_r$ and $\Delta\pi_{r+1}$) are also large. To evaluate ΔW^{*0}_r it is useful to define the second-best welfare function

$$\Psi_r(q) \equiv \widehat{\Psi}_r(p^{\mathcal{R}}_{r1}(q), q). \tag{34}$$

where

$$\begin{aligned}\widehat{\Psi}_r(p,q) \quad \equiv \quad & \pi_r + \sigma_r + w(p) - \frac{cp^2}{2} + \beta_F\left[u^0_{r2} + s^0_{r2} + w(p^0_{r2})\right] \\ & + \beta_F\left[p(1-q)\Theta^0_{r2} - (1-p)q\Theta^0_{r-1,2}\right] - \frac{\gamma q^2}{2},\end{aligned} \tag{35}$$

is the discounted social welfare that a social planner could achieve by specifying an arbitrary p and q in the first period, while allowing the no-activist equilibrium to unfold in periods 2 and 3, given whatever reputation level the firm ends up with a result of the planner's first-period choices. The second-best welfare function $\Psi_r(q)$ further restricts the planner's choices to (p, q) combinations that fall along the firm's reaction function, which is useful because the equilibria with and without the activist both lie along this reaction function. Thus,

$$\begin{aligned}W^0_{r1} &= \widehat{\Psi}_r(p^0_{r1}, 0) = \widehat{\Psi}_r(p^{\mathcal{R}}_{r1}(0), 0) = \Psi_r(0) \\ W^*_{r1} &= \widehat{\Psi}_r(p^*_{r1}, q^*_{r1}). = \widehat{\Psi}_r(p^{\mathcal{R}}_{r1}(q^*_{r1}), q^*_{r1}) = \Psi_r(q^*_{r1})\end{aligned}$$

Differentiating $\Psi_r(q)$ with respect to q yields

$$\Psi'_r(q) = \frac{\partial\widehat{\Psi}_r(p^{\mathcal{R}}_{r1}(q), q)}{\partial p}\frac{dp^{\mathcal{R}}_{r1}(q)}{dq} + \frac{\partial\widehat{\Psi}_r(p^{\mathcal{R}}_{r1}(q), q)}{\partial q}, \tag{36}$$

where

$$\frac{\partial\widehat{\Psi}_r(p,q)}{\partial p} = \omega - cp + \beta_F\left[(1-q)\Theta^0_{r2} + q\Theta^0_{r-1,2}\right] \tag{37}$$

$$\frac{\partial\widehat{\Psi}_r(p,q)}{\partial q} = -\beta_F\left[p\Theta^0_{r2} + (1-p)\Theta^0_{r-1,2}\right] - \gamma q \tag{38}$$

and from (8) and (17),

$$\frac{dp^{\mathcal{R}}_{r1}(q)}{dq} = \frac{\beta_F}{c}\left(\Delta u^0_{r-1,2} - \Delta u^0_{r2}\right) = p^0_{r-1,2} - p^0_{r2}. \tag{39}$$

Thus, substituting (37), 38), (39), and $p^{\mathcal{R}}_{r1}(q)$ into (36) yields:

$$\begin{aligned}\Psi'_r(q) &= \left[\omega - cp^{\mathcal{R}}(q)\right]\left[p^0_{r-1,1} - p^0_{r1}\right] \\ &\quad + \left\{\left[p^0_{r-1,1} - 2p^0_{r1}\right] - 2\left[p^0_{r-1,1} - p^0_{r1}\right] q\right\} \beta_F \Theta^0_{r2} \\ &\quad - \left\{\left[1 - p^0_{r1}\right] - 2\left[p^0_{r-1,1} - p^0_{r1}\right] q\right\} \beta_F \Theta^0_{r-1,2} \\ &\quad -\gamma q,\end{aligned}$$

We will employ the second-best welfare function presently. For now, we note that $\widehat{\Psi}_r(p, q)$ is strictly concave in (p, q), which is useful in generating a sufficient condition on parameters for the equilibrium with an activist to decrease social welfare (and thus a necessary condition for the activist's presence to be welfare improving).

Proposition 15 *Suppose the social returns to reputation are positive , i.e.,* $\Theta^0_{r-1,2} > 0$ *(and thus* $\Theta^0_{r2} > 0$*). Further suppose that* ω *is sufficiently small so that* $p^0_{r1} > \frac{\omega}{c} + \frac{\beta_F}{c} \max\left\{\Theta^0_{r-1,2}, \Theta^0_{r-1,2}\right\}$*. Then* $\Delta W^{*0}_r = \widehat{\Psi}_r(p^*_{r1}, q^*_{r1}) - \widehat{\Psi}_r(p^0_{r1}, 0) < 0$*.* `[DB: Sufficient condition changed]`

We can establish a complementary sufficient condition for the equilibrium with the activist to dominate.

Proposition 16 *Suppose that the social returns to reputation are sufficiently negative and the activist's cost is sufficiently small so that* $\gamma < \beta_F \min\left\{-\Theta^0_{r-1,2}, -\Theta^0_{r2}\right\}$*. Further suppose that* ω *is sufficiently large so that* $p^0_{r-1,1} < \frac{\omega}{c} + \frac{\beta_F \min\{\Theta^0_{r-1,2}, \Theta^0_{r2}\}}{c}$*. Then* $\Delta W^{*0}_r = \widehat{\Psi}_r(p^*_{r1}, q^*_{r1}) - \widehat{\Psi}_r(p^0_{r1}, 0) > 0$*.*

Figure 44 illustrates these propositions. In the left-hand panel (pertaining to Proposition 15), the social returns to reputation are positive and the marginal social benefit from abatement is sufficiently weak so that the equilibrium with the activist falls in the portion of (p, q) space where both the campaign and private regulation are "bads." (More precisely, $\frac{\partial \widehat{\Psi}_r(p,q)}{\partial p}$ is negative in the positive orthant and $p^{\mathcal{R}}_{r1}(q)$ lies everywhere above the locus of (p, q) such that $\frac{\partial \widehat{\Psi}_r(p,q)}{\partial p} = 0$.) In essence, an activist campaign will reduce social welfare in two ways: it induces a campaign in circumstances in which reputation building, rather than reputation destruction is socially beneficial, and it induces too much abatement from a social perspective. This implies that a necessary condition for the activist campaign to increase social welfare is that one or both of the conditions in Proposition 15 fails to hold, i.e., the social returns to reputation are non-positive or $p^0_{r1} \leq \frac{\omega}{c} + \frac{\beta_F \Theta^0_{r-1,2}}{c}$. As discussed above, the social returns to reputation embody the impact on abatement activity when the firm's reputation falls is thus more likely to be negative when ω is large. Thus, for an activist campaign to serve the public interest, it must be aimed at social harms for which there is a large marginal social benefits to abatement.

In the right-hand panel (pertaining to Proposition 16), the social returns to reputation are negative, the activist's cost is sufficiently low, and the marginal social benefit from abatement is

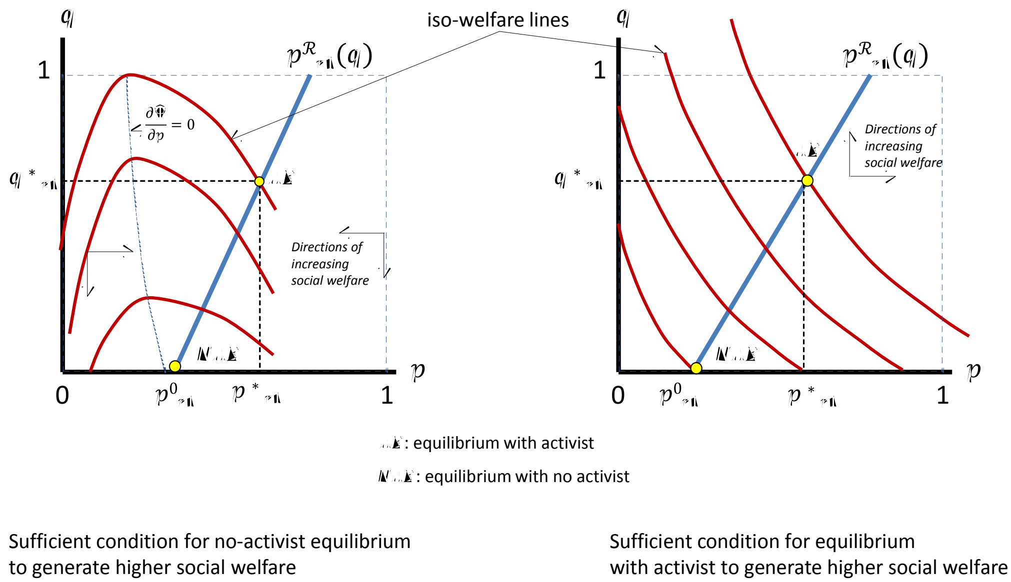

Figure 4: Illustration of sufficient conditions in Propositions 15 and 16.

sufficiently large so that the equilibrium without the activist falls within the portion of (p, q) space where both the campaign and private regulation are "goods." The activist's presence moves the outcome along $p_{r1}^{\mathcal{R}}(q)$ and thus increases social welfare. The two propositions, taken together, do not form and "if and only if" result. But they are close. A high value of ω is necessary for an activist campaign to increase discounted social welfare and (provided γ is low enough) is also sufficient. This theme recurs below.

We now evaluate the impact of welfare for a series of special cases distinguished by whether the major harm condition (33) holds or does not hold and by whether the activist is strong or weak. We do this, rather than algebraically evaluating ΔW_r^{*0} using the equilibrium conditions (**??**) and (**??**), to circumvent hard-to-interpret algebraic expressions. These cases provide a manageable analysis of the impact of the activist campaigns on social welfare that offer insight into the economic forces at work in the model. To explain what we mean by a strong or weak activist, we note that by varying the activist-specific parameters ψ and β_A we shift the activist's reaction function and "move" the equilibrium along the firm's reaction function. However, ψ and β_A have no impact on social welfare, so the only welfare impact of this comparative static exercise is through its effect on the period 1 equilibrium. For ψ and/or β_A large enough, condition (**??**) will hold, and $q_{r1}^* = 1$. If on the other hand, ψ and/or $\beta_A = 0$, then (**??**) implies that $q_{r1}^* = 0$. Moreover, as Proposition 10 showed, q_{r1}^* is strictly increasing in ψ and β_A when $q_{r1}^* < 1$. And once $q_{r1}^* > \frac{1}{2}$,Proposition 10 also implies that h_{ur}^* is strictly decreasing in ψ and β_A. Accordingly, we distinguish between two cases: a strong activist—ψ and β_A sufficiently large so that $q_{r1}^* = 1$ or $q_{r1}^* \approx 1$—and a weak activist—ψ and β_A sufficiently close to 0 so q_{r1}^* is close to 0. Pulling this together, we have four scenarios to consider:

1. Strong activist, negative social returns to corporate reputation (i.e., the major harm condition (33) holds).
2. Strong activist, positive social returns to corporate reputation.
3. Weak activist, negative social returns to corporate reputation
4. Weak activist, positive social returns to corporate reputation.

We examine each case in turn.

Proposition 17 *Suppose the activist is strong and there are negative social returns to corporate reputation (i.e., condition (33) holds). Furthermore suppose γ is positive but sufficiently small and η is not too negative (more specifically, $\eta > -\theta$). Then the presence of the activist increases social welfare.*

Equilibrium campaign effort by a strong, cost-efficient activist, in a situation in which the social marginal benefit of abatement is large enough will, according to Proposition 17, create more discounted social welfare than would have been the case in the absence of the activist. The activist spurs more private regulation in the first period, in a situation in which more private regulation enhances value, and it unambiguously shifts the distribution of reputation states in period 2 downward, in a situation in which the social returns to corporate reputation are negative (or equivalently, the social returns to harming reputation are positive). A possible scenario under which these conditions might prevail would be one where:

- The issue on which the firm's reputation hangs in the balance has already been well reported in the media, so the additional cost to the activist of drawing public attention to it is low.
- The net social benefit of even a little more abatement activity by the firm is very high, possibly because very little is currently being done to mitigate the social harm.

Activist campaigns launched against high-profile firms in the wake of accidents in which the firm or its suppliers are implicated as having done too little to prevent the accident might be an example of this set of circumstances.

If, in contrast to the premise of Proposition 17, the activist is strong but there are positive social returns to corporate reputation, then the impact of the activist on social welfare is ambiguous. With $\Theta^0_{r2} > 0$ and $\Theta^0_{r-1,2} > 0$ (but still $h^*_{ur} - h^0_{ur}$), the middle terms of ΔW^{*0}_r are now negative, forcing social welfare with an activist below social welfare without an activist. However, even if the inequality in (33) goes in the other direction, it is still possible that the increase in first-period private regulation engendered by the activist increases first-period welfare. In this case, the presence of the strong activist would increase social welfare in the first period, while decreasing it in the second period. However, if the marginal benefit of abatement is sufficiently low, additional private regulation in period 1 might actually go too far and reduce social welfare. This gives us our next proposition.

Proposition 18 *Suppose the activist is strong and there are positive social returns to corporate reputation (i.e., the inequality in (33) is reversed). Then the impact of the activist on expected social welfare in period 2 is unambiguously negative, but its impact on first period social welfare is ambiguous and thus the sign of* ΔW_r^{*0} *is ambiguous. However, if in addition,*

$$\omega < \beta_F \Delta\pi_{r+1}, \tag{40}$$

(which implies $p^S < p^0_{r+1,2} < p^0_{r2} < p^0_{r-1,2}$*), the presence of the activist decreases discounted expected social welfare, i.e.,* $\Delta W_r^{*0} < 0$.

Given (40), the strong pushes the firm to do even more abatement activity when it is already doing "too much" from a social perspective in period 1. Moreover, the activist puts the firm's reputation at risk in a situation in which greater reputation actually improves period-two profits and consumer surplus by more than it reduces the net social benefits from abatement activity in period 2. A possible example in which this set of circumstances may prevail is when the activist is extremely passionate, while the firm's private regulation has a minimal impact on the social benefit w but a more substantial impact on public perceptions that shape the firm's reputation. An example might be circumstances under which the firm's incremental abatement effort is a small contribution to a high level of aggregate abatement effort from many other agents in the economy. The marginal contribution of the firm's effort will be small (so p^S is low), but it is conceivable that the firm will increase the odds of a reputation boost from its efforts. Widely publicized steps that firms take to reduce their carbon footprint might fall into this category.

Turning now the case of a weak activist, a weak activist's equilibrium campaign intensity is close to zero, so the impact of a weak activist on social welfare is given by the sign of $\Psi_r'(0)$:

$$\Psi_r'(0) = \left[\omega - cp^0_{r1}\right]\left[p^0_{r-1,1} - p^0_{r1}\right] + \left[p^0_{r-1,1} - 2p^0_{r1}\right]\beta_F \Theta^0_{r2} - \left[1 - p^0_{r1}\right]\beta_F \Theta^0_{r-1,2}. \tag{41}$$

If $\Psi_r'(0) > 0$, a weak activist's presence increases discounted social welfare and if $\Psi_r'(0) < 0$ it decreases social welfare. In general, the sign of $\Psi_r'(0)$ is ambiguous, but it depends importantly on a term discussed earlier: $p^0_{r-1,1} - 2p^0_{r1}$, which can be shown to equal

$$\Delta\pi_{r-1}\frac{\beta_F}{c}\left\{(1+\beta_F)\left[1-2\theta\right] - \frac{\beta_F^2 \Delta\pi_{r-1}\left(1-\theta^2\right)\left(1-2\theta^2\right)}{2c}\right\} \tag{42}$$

The term in curly brackets is positive for $\theta = 0$, negative for $\theta = 1$, and it strictly decreases in

$\theta = 0$.[24] Thus, for θ sufficiently small (strong DSRR) $p^0_{r-1,1} - 2p^0_{r1} > 0$ and for θ sufficiently large (weak DSRR) $p^0_{r-1,1} - 2p^0_{r1} < 0$. This gives us our next proposition.

Proposition 19 *Suppose the activist is weak and the social returns to corporate reputation are negative. In general, the activist's presence has an ambiguous impact on social welfare. However, if diminishing static returns to reputation are sufficiently weak, i.e., the expression in (42) is negative, then the presence of the activist increase discounted expected social welfare, i.e.,* $\Delta W_r^{*0} > 0$.

When there are weak static diminishing returns to reputation, the firm's private regulation is not very sensitive to the activist's campaign. This ensures that the additional private regulation that the firm undertakes in the first does not offset the campaign and on net the probability that the firm's reputation improves in the second period goes down. When there are negative social returns to corporate reputation, this benefits society. Even when an activist is weak, then, its presence can still benefit society.

The opposite case—weak activist and positive social returns to reputation is ambiguous in general, but again there are circumstances under which the impact of its presence can be discerned.

Proposition 20 *Suppose the activist is weak and the social returns to corporate reputation are positive. In general, the activist's presence has an ambiguous impact on social welfare. However, if (40) holds and if diminishing static returns to reputation are sufficiently weak, i.e., the expression in (42) is negative, then the presence of the activist decreases discounted expected social welfare, i.e.,* $\Delta W_r^{*0} < 0$.

Propositions 17-20 do not fully characterize the welfare impact of the activist, but they provide a strong suggestion of the factors that play an important role in determining whether the activist has a positive impact on social welfare or negative one: the social returns to corporate reputation in the second period and the extent to which private regulation in the absence of the activist over-delivers or under-delivers abatement activity in period 1. When social returns to corporate reputation are negative, the firm will underdeliver abatement activity in period 1 and a strong activist plays a constructive role by inducing more private regulation in periods 1 and 2. This will increase welfare if the activist's marginal costs are not too high. A weak activist can also do this, but diminishing returns to reputation must be weak enough that the increase in the firm's private regulation does

[24] The derivative of the expression in curly brackets with respect to θ is

$$-2(1+\beta_F) - \frac{\beta_F^2 \Delta\pi_{r-1}}{2c}\left[8\theta^3 - 6\theta\right].$$

The only way this can fail to be negative is if the term $8\theta^3 - 6\theta$. This is a convex function that attains its minimum at $\theta = \frac{1}{16}$. At this value $8\theta^3 - 6\theta = -0.373046875$. Given this, the value of the term in curly brackets is

$$-2(1+\beta_F) + \frac{0.373046875\beta_F^2 \Delta\pi_{r-1}}{2c}.$$

But because $\frac{\beta_F \Delta\pi_{r-1}}{c} < 1$, this expression is still negative.

not more than offset the activist's campaign, resulting in an increase in the probability that the firm's reputation goes up.

When social returns to reputation are positive, an activist is a negative force. As discussed above, social returns to reputation go up when, among other things, the marginal social benefit of abatement activist is low and reputation spillovers to consumers are high.

To further characterize the welfare effects of the activist, we note that changes in the activist's parameters can position the equilibrium anywhere along the firm's reaction function, and because they do not directly enter into the expression for discounted social welfare, there exists a value of ψ that maximizes second-best welfare $\Psi_r(q)$. One can think of the activist's passion as roughly analogous to a term in an incentive contract: by "hiring" an activist with an appropriate passion, society can induce the best possible outcome, subject, of course, to the constraint that abatement activity is being delegated to a reputation-driven firm and pressure on that firm is provided by an activist whose preferences are not fully aligned with society's. If society's best outcome occurs at $q = 0$, society can implement this by "not hiring" the activist and that outcome would be preferable to any equilibrium with an activist (which necessarily results in $q^*_{r1} > 0$. The formulation thus provides a useful way to further characterize circumstances in which society would prefer the equilibrium without an activist to one in which the activist is present.

Note that the welfare function $\Psi_r(q)$ may be either concave or convex:

$$\Psi''_r(q) = -c\left[p^0_{r-1,1} - p^0_{r1}\right]^2 - 2\left[p^0_{r-1,1} - p^0_{r1}\right]\beta_F\left[\Theta^0_{r-1,2} - \Theta^0_{r2}\right] - \gamma$$

The welfare function is strictly convex if and only if

$$\Theta^0_{r-1,2} > \frac{c\left[p^0_{r-1,1} - p^0_{r1}\right]}{\beta_F(1-\theta)} + \frac{\gamma}{\beta_F\left[p^0_{r-1,1} - p^0_{r1}\right](1-\theta)}. \tag{43}$$

In this case, the "optimal activist" is one that results in either $q^*_{r1} = 1$ (if $\Psi(1) > \Psi(0)$) or $q^*_{r1} = 0$ (if $\Psi(0) > \Psi(1)$). This latter case would imply that society would strictly prefer the no-activist equilibrium to the equilibrium with the activist. This leads to the following result:

Proposition 21 *If (43) holds, then society prefers the no-activist equilibrium to the equilibrium with the activist.*

This result complements Proposition 15 and reinforces our earlier insight: if the social returns to reputation in period 2 are sufficiently large, then society is better off if the activist did not try to affect the firm's private regulation. In light of Lemma 4, if marginal social benefit of abatement is sufficiently small, if the firm is not especially risk averse with respect to reputation loss, if private returns to reputation are sufficiently large, or if reputation spillovers to consumers are sufficiently strong, society would prefer that the activist not launch a campaign.

4.1.4 Numerical analysis

To further illustrate how the activist's presence impacts social welfare, we report numerical calculations over portions of parameter space. Tables 1 and 2 show the percentage change in discounted social welfare (relative to the no-activist equilibrium) due to the presence of the activist for combinations of four parameters: ω, θ, $\Delta\pi_{r-1}$, and ψ.[25] Over the range of parameter space shown, the presence of the activist often decreases social welfare, although in many cases by just a few percent points. But when the activist does increase social welfare—which tends to occur when the firm is highly risk averse with respect to its reputation (θ sufficiently low) and the marginal social benefit of abatement activity is large (ω sufficiently large)—the impact can be significant. For example, when $\theta = 0.10$, $\omega = 640, \Delta\pi_{r-1} = 40$, and $\psi = 2$, the presence of the activist more than doubles discounted social welfare. For parameter values for which the activist's presence significantly increases social welfare, what generally happens is that there is a high likelihood that the firm will experience a decrease in its reputation between periods 1 and 2 which, as discussed, does two things: it makes the firm more likely to choose a higher level of private regulation in period 2 than it would have otherwise, and it induces the firm to choose a higher level of private regulation in period 1. There may also be a reduction in the likelihood that the firm improves its reputation, which also makes it more likely that the firm will undertake more private regulation in period 2. For example, when $\theta = 0.10$, $\omega = 640, \Delta\pi_{r-1} = 40$, and $\psi = 2$, first-period private regulation in state r in the absence of the activist is given by $p^0_{r1} = 0.0916$, but it jumps to $p^*_{r1} = 0.7652$. The probability of a reputation loss between periods 1 and 2 is $h^*_{dr} = q^*_{r1} = 0.9246$, while the probability that the firm's reputation improves decreases by 0.0339.

The range of values (θ, ω) over which $\Delta W^{0*}_r > 0$ (shown in bold) is fairly insensitive to variation in the private marginal benefit of private regulation $\Delta\pi_{r-1}$ and the passion of the activist ψ. However, when there are welfare gains from campaigns, a more passionate activist tends to accentuate their magnitude, and when there are welfare losses from campaigns, a more passionate activist tends to accentuate those too. A similar pattern holds with respect to $\Delta\pi_{r-1}$.

By and large, the numerical analysis tends to confirm the intuition developed above. When the social marginal benefit of abatement is sufficiently large, the presence of the activist motivates the firm to increase abatement effort in the first period that it otherwise would have undersupplied. It also makes it possible that the firm will either take a hit to its reputation, or fail to improve its reputation, motivating it in the second period to undertake more private regulation than it would have otherwise. When the social benefits of private regulation are sufficiently large in comparison to the profit and consumer surplus sacrificed owing to the firm's lower reputation, this is a trade-off that benefits society.

[25] The other parameter values whose values remained fixed in these calculations are: $\beta_F = 0.95$, $\beta_A = 0.95$, $c = 80$, $\gamma = 175$, $\pi_{r-1} = 0$, $\eta = 0.25$, and $\sigma_r = 1$.

	$\Delta\pi_{r-1} = 20, \psi = 1$						$\Delta\pi_{r-1} = 20, \psi = 2$				
	θ						θ				
ω	0.10	0.30	0.50	0.70	0.90	$\boldsymbol{\omega}$	0.10	0.30	0.50	0.70	0.90
1	−0.1%	0.0%	0.0%	0.0%	0.0%	1	−0.1%	−0.1%	−0.1%	−0.1%	−0.0%
10	−0.6%	−0.4%	−0.3%	−0.2%	−0.1%	10	−1.2%	−0.9%	−0.7%	−0.4%	−0.2%
20	−1.0%	−0.80%	−0.6%	−0.4%	−0.2%	20	−2.1%	−1.6%	−1.2%	−0.8%	−0.3%
40	−1.4%	−1.2%	−1.0%	−0.7%	−0.3%	40	−3.2%	−2.6%	−2.0%	−1.4%	−0.6%
80	−0.5%	−1.0%	−1.2%	−1.0%	−0.4%	80	−2.6%	−2.9%	−2.7%	−2.0%	−0.9%
160	**7.1**%	**2.0**%	−0.3%	−0.9%	−0.6%	160	**8.1**%	**1.2**%	−1.7%	−2.2%	−1.2%
320	**39.0**%	**14.1**%	**4.1**%	**0.1**%	−0.6%	320	**56.0**%	**20.0**%	**5.1**%	−0.7%	−1.3%
640	**138.4**%	**47.8**%	**16.4**%	**3.6**%	−0.3%	640	**202.1**%	**72.7**%	**24.9**%	**4.8**%	−1.0%

Table 1: Difference in discounted social welfare as a percentage of social welfare in no-activist equilibrium, i.e., $\Delta W_r^{0*}/W_{r1}^0$, for selected parameter values. (Bold indicates case in which equilibrium with the activist results in higher discounted social welfare.)

	$\Delta\pi_{r-1} = 40, \psi = 1$						$\Delta\pi_{r-1} = 40, \psi = 2$				
	θ						θ				
$\boldsymbol{\omega}$	0.10	0.30	0.50	0.70	0.90	$\boldsymbol{\omega}$	0.10	0.30	0.50	0.70	0.90
1	−0.1%	−0.1%	−0.1%	−0.0%	−0.0%	1	−0.2%	−0.2%	−0.1%	−0.1%	−0.0%
10	−1.0%	−0.8%	−0.6%	−0.4%	−0.2%	10	−2.1%	−1.5%	−1.2%	−0.8%	−0.4%
20	−1.8%	−1.3%	−1.0%	−0.8%	−0.3%	20	−3.7%	−2.7%	−2.1%	−1.5%	−0.7%
40	−2.4%	−2.0%	−1.7%	−1.3%	−0.6%	40	−5.4%	−4.3%	−3.6%	−2.7%	−1.2%
80	−0.8%	−1.8%	−2.2%	−1.9%	−1.0%	80	−3.9%	−4.8%	−4.9%	−4.1%	−1.9%
160	**11.3**%	**2.8**%	−0.8%	−2.0%	−1.3%	160	**13.2**%	**1.79**%	−3.3%	−4.7%	−2.7%
320	**56.0**%	**21.1**%	**6.3**%	−0.2%	−1.4%	320	**75.2**%	**29.5**%	**7.8**%	−2.1%	−3.0%
640	**170.4**%	**67.0**%	**26.0**%	**6.1**%	−1.0%	640	**219.1**%	**95.2**%	**39.6**%	**8.4**%	−2.4%

Table 2: Difference in discounted social welfare as a percentage of social welfare in no-activist equilibrium, i.e., $\Delta W_r^{0*}/W_{r1}^0$, for selected parameter values. (Bold indicates case in which equilibrium with the activist results in higher discounted social welfare.)

5 Conclusions

To be written

6 Appendix

6.1 Proofs

Proof of Proposition 1:

Period 3 is the terminal period, so there is no gain from undertaking private regulation, establishing (6) and (10). And since $\Delta\pi_r > 0$ by assumption, (13) holds for $t = 3$.

Conditions (7) and (11) follow from solving the Kuhn-Tucker conditions in period 2 with $q = 0$. The fact that $p^0_{r2} \in (0,1)$, is an implication of Assumption 1: $c > \beta_F(1+\beta_F)\Delta\pi_r > \beta_F\Delta\pi_r$. From (11)

$$\begin{aligned}\Delta u^0_{r2} &= u^0_{r+1,2} - u^0_{r2} = \left\{(1+\beta_F)\pi_{r+1} + \frac{\beta_F^2}{2c}\left(\Delta\pi_{r+1}\right)^2\right\} - \left\{(1+\beta_F)\pi_r + \frac{\beta_F^2}{2c}\left(\Delta\pi_r\right)^2\right\} \\ &= (1+\beta_F)\Delta\pi_r + \frac{\beta_F^2}{2c}\left[\left(\Delta\pi_{r+1}\right)^2 - \left(\Delta\pi_r\right)^2\right]. \qquad (44)\end{aligned}$$

Noting that $\left(\Delta\pi_{r+1}\right)^2 - \left(\Delta\pi_r\right)^2 = \left[\Delta\pi_{r+1} - \Delta\pi_r\right]\left[\Delta\pi_{r+1} + \Delta\pi_r\right]$, with some slight algebraic rearrangement, (44) can be written as

$$\Delta u^0_{r2} = (1 + \beta_F - \frac{\beta_F^2\left[\Delta\pi_{r+1} + \Delta\pi_r\right]}{2c})\Delta\pi_r + \frac{\beta_F^2\left[\Delta\pi_{r+1} + \Delta\pi_r\right]}{2c}\Delta\pi_{r+1} > 0,$$

where the inequality follows because, $\frac{\beta_F}{c}\frac{\left[\Delta\pi_{r+1}+\Delta\pi_r\right]}{2} < 1$ from Assumption 1 and thus $1 + \beta_F - \frac{\beta_F^2\left[\Delta\pi_{r+1}+\Delta\pi_r\right]}{2c} > 0$. This establishes (13) for $t = 2$.

Conditions (8) and (12) also follow from solving the Kuhn-Tucker conditions in period 1 with $q = 0$. The fact that $p^0_{r1} \in (0,1)$ follows because from (44)

$$\begin{aligned}\frac{\beta_F\Delta u^0_{r2}}{c} &= \frac{\beta_F(1+\beta_F)\Delta\pi_r}{c} + \frac{\beta_F^3}{2c^2}\left[\left(\Delta\pi_{r+1}\right)^2 - \left(\Delta\pi_r\right)^2\right] \\ &< \frac{\beta_F(1+\beta_F)\Delta\pi_r}{c} < 1,\end{aligned}$$

where the first inequality follows because $\left(\Delta\pi_{r+1}\right)^2 < \left(\Delta\pi_r\right)^2$ by DSRR and the second follows from Assumption 1.

To prove that $\Delta u^0_{r1} > 0$, we note that p^0_{r1} is feasible, though not necessarily optimal in reputation state $r+1$. Thus,

$$u^0_{r+1,1} \geq \pi_{r+1} - \frac{c\left(p^0_{r1}\right)^2}{2} + \beta_F u^0_{r+1,2} + \beta_F\Delta u^0_{r+1,2}p^0_{r1}.$$

Also

$$u^0_{r1} = \pi_r - \frac{c\left(p^0_{r1}\right)^2}{2} + \beta_F u^0_{r2} + \beta_F \Delta u^0_{r2} p^0_{r1}.$$

Thus,

$$\Delta u^0_{r1} = u^0_{r+1,1} - u^0_{r1} \geq \Delta\pi_r + \beta_F \Delta u^0_{r2}\left(1 - p^0_{r1}\right) + \beta_F \Delta u^0_{r+1,2} p^0_{r1}.$$

Having just established $\Delta u^0_{r2} > 0$ and $\Delta u^0_{r+1,2} > 0$, and since $\Delta\pi_r > 0$, it follows that $\Delta u^0_{r1} > 0$, establishing (13) for $t = 1$.

Finally, using (44) and (7), we have

$$\frac{\partial \Delta u^0_{r2}}{\partial \beta_F} = \Delta\pi_r\left(1 - p^0_{r2}\right) + \frac{\beta_F}{2c}\left(\Delta\pi_{r+1}\right)^2 > 0.$$

■

Proof of Proposition 2:

Using (44), we have

$$\begin{aligned}
\Delta u^0_{r-1,2} - \Delta u^0_{r2} &= (1+\beta_F)\left[\Delta\pi_{r-1} - \Delta\pi_r\right] + \frac{\beta_F^2}{2c}\left\{\left[(\Delta\pi_r)^2 - (\Delta\pi_{r-1})^2\right] - \left[(\Delta\pi_{r+1})^2 - (\Delta\pi_r)^2\right]\right\} \\
&= (1+\beta_F)\left[\Delta\pi_{r-1} - \Delta\pi_r\right] + \frac{\beta_F^2}{2c}\left\{\begin{array}{c} \left[\Delta\pi_r - \Delta\pi_{r-1}\right]\left[\Delta\pi_r + \Delta\pi_{r-1}\right] \\ -\left[\Delta\pi_{r+1} - \Delta\pi_r\right]\left[\Delta\pi_{r+1} + \Delta\pi_r\right] \end{array}\right\} \\
&= \left\{\begin{array}{c} \left\{1 + \beta_F\left[1 - \frac{\beta_F\left(\frac{\Delta\pi_r + \Delta\pi_{r-1}}{2}\right)}{c}\right]\right\}\left[\Delta\pi_{r-1} - \Delta\pi_r\right] \\ +\frac{\beta_F^2}{2c}\left[\Delta\pi_r - \Delta\pi_{r+1}\right]\left[\Delta\pi_{r+1} + \Delta\pi_r\right] \end{array}\right\} > 0 \qquad (45)
\end{aligned}$$

where the last inequality follows because Assumption 1 implies $\frac{\beta_F \Delta\pi_r}{c} < 1$ and $\frac{\beta_F \Delta\pi_{r-1}}{c} < 1$, making $\left[1 - \frac{\beta_F\left(\frac{\Delta\pi_r + \Delta\pi_{r-1}}{2}\right)}{c}\right]$ positive.[26] The result that $p^0_{r+1,1} < p^0_{r1}$ follows immediately from (8).■

Proof of Proposition 3:

Because $p^0_{r3} = 0$, it suffices to show that $p^0_{r1} \geq p^0_{r2}$. From (7) and (8) that inequality turns on the comparison between Δu^0_{r2} and $\Delta\pi_r$. From (11)

$$\begin{aligned}
\Delta u^0_{r2} &= (1+\beta_F)\Delta\pi_r + \frac{\beta_F^2}{2c}\left[(\Delta\pi_{r+1})^2 - (\Delta\pi_r)^2\right] \\
&= \Delta\pi_r + \beta_F\Delta\pi_r + \frac{\beta_F^2}{2c}\left[(\Delta\pi_{r+1})^2 - (\Delta\pi_r)^2\right] \\
&= \Delta\pi_r + \beta_F\Delta\pi_r + \frac{\beta_F^2}{2c}\left[\Delta\pi_{r+1} - \Delta\pi_r\right]\left[\Delta\pi_{r+1} + \Delta\pi_r\right] \\
&= \Delta\pi_r + \beta_F\Delta\pi_r + \beta_F\left[\Delta\pi_{r+1} - \Delta\pi_r\right]\frac{\beta_F}{c}\frac{\left[\Delta\pi_{r+1} + \Delta\pi_r\right]}{2}
\end{aligned}$$

[26] Assumption 1 is not needed to prove this Proposition. If we allow for corner solutions on p_{r2}, Proposition 2 can still be shown to hold.

To prove the result, it suffices to prove that $\beta_F \Delta\pi_r + \beta_F \left[\Delta\pi_{r+1} - \Delta\pi_r\right] \frac{\beta_F}{c} \frac{[\Delta\pi_{r+1}+\Delta\pi_r]}{2} > 0$. This can be rewritten as

$$\left\{1 - \frac{\beta_F}{c} \frac{[\Delta\pi_{r+1} + \Delta\pi_r]}{2}\right\} \beta_F \Delta\pi_r + \left\{\frac{\beta_F}{c} \frac{[\Delta\pi_{r+1} + \Delta\pi_r]}{2}\right\} \beta_F \Delta\pi_{r+1}.$$

Now, by Assumption 1, $\frac{\beta_F}{c}\Delta\pi_r < 1$ and $\frac{\beta_F}{c}\Delta\pi_{r+1} < 1$, so $\frac{\beta_F}{c}\frac{[\Delta\pi_{r+1}+\Delta\pi_r]}{2} < 1$. Thus

$$\left\{1 - \frac{\beta_F}{c} \frac{[\Delta\pi_{r+1} + \Delta\pi_r]}{2}\right\} \beta_F \Delta\pi_r + \left\{\frac{\beta_F}{c} \frac{[\Delta\pi_{r+1} + \Delta\pi_r]}{2}\right\} \beta_F \Delta\pi_{r+1} > \beta_F \Delta\pi_{r+1} > 0.$$

Hence $\Delta u^0_{r2} > \Delta\pi_r$.■

Proof of Proposition 4:

Proposition 3 implies $p^0_{r2} < p^0_{r1}$. Proposition 1 and DSRR together imply $p^0_{r+1,2} < p^0_{r2}$. Thus $p^0_{r+1,2} < p^0_{r1}$.■

Proof of Lemma 1:

The first two parts of the lemma follow immediately from the fact that the third period is the terminal period of the game. Thus, $u^*_{r3} = \pi_r$, and (from 3) $v^*_{r3} = 0$.Now, using (3) again, we have $v_{r2} = \max_{q_{rt}\in[0,1]} \psi w(p^*_{r2}) - \frac{\gamma q^2_{r2}}{2}$, which implies $q^*_{r2} = 0$ and $v^*_{r2} = w(p^*_{r2})$.■

Proof of Lemma 2:

This follows immediately from $q^*_{r2} = 0$.■

Proof of Lemma 3:

$\Delta v^*_{r2} = v^*_{r+1,2} - v^*_{r2} = \psi\left[w(p^0_{r+1,2}) - w(p^0_{r2})\right] < 0$ because $p^0_{r+1,2} < p^0_{r2}$ from Proposition 1.■

Proof of Proposition 6:

Condition (17) in conjunction with (8) implies

$$p^*_{r1} = p^0_{r1} + q^*_{r1}\left(p^0_{r-1,1} - p^0_{r1}\right) > p^0_{r1}$$

because from (18) $q^*_{r1} > 0$ and from Proposition 2, $p^0_{r-1,1} > p^0_{r1}$.■

Proof of Proposition 8:

Define a function $\Delta h_{ur}(q) \equiv p^R_{r1}(q)(1-q) - p^0_{r1}$. This is the difference in the transition probability from r to $r+1$ when an activist chooses an arbitrary q and the firm reacts optimally and when there is no activist. Using (17) and (18), we note that:

$$\begin{aligned}
\Delta h_{ur}(0) &= 0. \\
\Delta h_{ur}(q^*_{r1}) &= h^*_{ur} - h^0_{ur}. \\
\frac{d\Delta h_{ur}(q)}{dq} &= \frac{dp^{\mathcal{R}}_{r1}(q)}{dq}(1-q) - p^{\mathcal{R}}_{r1}(q) = \left[p^0_{r-1,1} - p^0_{r1}\right](1-2q) - p^0_{r1}. \\
\frac{d\Delta h_{ur}(0)}{dq} &= \left[p^0_{r-1,1} - 2p^0_{r1}\right]. \\
\frac{d^2\Delta h_{ur}(q)}{dq^2} &= -2\left[p^0_{r-1,1} - p^0_{r1}\right] < 0.
\end{aligned}$$

From (8), $\Delta u^0_{r-1,2} - 2\Delta u^0_{r2} < 0$ is equivalent to $p^0_{r-1,1} - 2p^0_{r1} < 0$, which in turn implies $\Delta h'_{ur}(0) < 0$. Given $\Delta h''_{ur}(q) < 0$, it follows that $\Delta h_{ur} < 0$ for all q including $q = q^*_{r1}$.■

Proof of Proposition 9:

Solving (17) and (18) simultaneously under the assumption that $q < 1$ yields (20) and (21). Turning to the necessary and sufficient condition for the corner equilibrium, first, if $\frac{\beta_A\psi}{\gamma}\left[\Delta w^0_{r-1,2}\left(1 - \frac{\beta_F\Delta u^0_{r-1,2}}{c}\right)\right.$ -
1, then $q^{\mathcal{R}}_{r1}(\frac{\beta_F\Delta u^0_{r-1,2}}{c}) = 1$. From (17), $\frac{\beta_F\Delta u^0_{r-1,2}}{c}$ is the highest possible equilibrium value for p, and thus, $p^*_{r1} \leq \frac{\beta_F\Delta u^0_{r-1,2}}{c}$. Moreover, from (15) and (16), $\Delta w^0_{r-1,2} > \Delta w^0_{r2}$, so the reaction function $q^{\mathcal{R}}_{r1}(p)$ is non-increasing in p. Thus, $q^*_{r1} = q^{\mathcal{R}}_{r1}(p^*_{r1}) \geq q^{\mathcal{R}}_{r1}(\frac{\beta_F\Delta u^0_{r-1,2}}{c}) = 1$, but since $q^{\mathcal{R}}_{r1}(p)$ cannot be greater than 1, we must have $q^*_{r1} = 1$.

Now, if $q^*_{r1} = 1$, then from (17), $p^*_{r1} = \frac{\beta_F\Delta u^0_{r-1,2}}{c}$. Also, since $1 = q^*_{r1} = q^{\mathcal{R}}_{r1}(p^*_{r1})$, it must be the case that $\min\left\{\frac{\beta_A\psi}{\gamma}\left[\Delta w^0_{r-1,2} - \left(\Delta w^0_{r-1,2} - \Delta w^0_{r2}\right)\left(\frac{\beta_F\Delta u^0_{r-1,2}}{c}\right)\right], 1\right\} = 1$, which implies that $\frac{\beta_A\psi}{\gamma}\left[\Delta w^0_{r-1,2}\left(1 - \frac{\beta_F\Delta u^0_{r-1,2}}{c}\right) + \Delta w^0_{r2}\frac{\beta_F\Delta u^0_{r-1,2}}{c}\right] \geq 1$. ■

Proof of Proposition 10:

We have already proved the first part of the proposition. To establish the second, recall that $h^*_{ur} = p^*_{r1}(1-q^*_{r1}) = p^{\mathcal{R}}_{r1}(q^*_{r1})(1-q^*_{r1})$. Consider the case of ψ. $\frac{dh^*_{ur}}{d\psi} = \left[\frac{dp^{\mathcal{R}}_{r1}(q^*_{r1})}{dq}(1-q^*_{r1}) - p^{\mathcal{R}}_{r1}(q^*_{r1})\right]\frac{\partial q^*_{r1}}{\partial\psi} = \left\{\left[p^0_{r-1,1} - p^0_{r1}\right](1-2q^*_{r1}) - p^0_{r1}\right\}\frac{\partial q^*_{r1}}{\partial\psi}$, where $\frac{\partial q^*_{r1}}{\partial\psi} > 0$. For a large enough value of ψ, $q^*_{r1} > \frac{1}{2}$, and $\frac{dh^*_{ur}}{d\psi} < 0$. The same logic holds for the other parameters: β_A, ω, γ.■

Proof of Proposition 12:

We note that $p^{\mathcal{R}}_{r1}(q) = \frac{\beta_F}{c}\left[(1-q)\Delta u^0_{r2} + q\Delta u^0_{r-1,2}\right]$ and $p^{\mathcal{R}}_{r-1,1}(q) = \frac{\beta_F}{c}\left[(1-q)\Delta u^0_{r-1,2} + q\Delta u^0_{r-2,2}\right]$. From DDRR from Proposition 2, $\Delta u^0_{r-2,2} > \Delta u^0_{r-1,2} > \Delta u^0_{r-1,2}$, so $p^{\mathcal{R}}_{r-1,1}(q) > p^{\mathcal{R}}_{r1}(q)$ for any $q \in [0,1]$. Thus, a decrease in r shifts the firm's reaction function rightward, as in Figure **??**. We also note that $q^{\mathcal{R}}_{r1}(p) = \min\left\{\frac{\beta_A\psi}{\gamma}\left[(1-p)\Delta w^0_{r-1,2} + p\Delta w^0_{r2}\right], 1\right\}$ and $q^{\mathcal{R}}_{r-1,1}(p) = \min\left\{\frac{\beta_A\psi}{\gamma}\left[(1-p)\Delta w^0_{r-2,2} + p\Delta w^0_{r-1,2}\right.\right.$
From (15) and (16), $\Delta w^0_{r-1,2} > \Delta w^0_{r2}$, and it is straightforward to show that $\Delta w^0_{r-2,2} > \Delta w^0_{r-1,2}$. Thus, $q^{\mathcal{R}}_{r-1,1}(p) \geq q^{\mathcal{R}}_{r1}(p)$ for any $p \in [0,1]$. Thus, a decrease in r shifts the activist's reaction function upwards as shown in Figure **??** or not at all. As a result, $p^*_{r-1,1} > p^*_{r1}$. ■

Proof of Proposition 13:

In Proposition 6, we established $p^*_{r1} > p^0_{r1}$; thus, $w(p^*_{r1}) > w(p^0_{r1})$. Because $q = 0$ is a feasible but not optimal solution to the activist's optimization problem, it follows that

$$\psi w(p^*_{r1})+\beta_A\psi w(p^0_{r2})-\beta_A h^*_{ur}\psi\Delta w^0_{r2}+\beta_A h^*_{dr}\psi\Delta w^0_{r-1,2}-\frac{\gamma}{2}\left(q^*_{r1}\right)^2 > \psi w(p^*_{r1})+\beta_A\psi w(p^0_{r2})-\beta_A p^*_{r1}\psi\Delta w^0_{r2},$$

or equivalently,

$$-\beta_A h^*_{ur}\psi\Delta w^0_{r2} + \beta_A h^*_{dr}\psi\Delta w^0_{r-1,2} - \frac{\gamma}{2}\left(q^*_{r1}\right)^2 > -\beta_A p^*_{r1}\psi\Delta w^0_{r2}.$$

This implies

$$\Delta V^*_{r0} > \psi\left\{\left[w(p^*_{r1}) - w(p^0_{r1})\right] - \beta_A\left[p^*_{r1} - p^0_{r1}\right]\Delta w^0_{r2}\right\}.$$

Rearranging terms and using (15), the right-hand side of the above inequality can be written as

$$= \omega\psi\left[p^*_{r1} - p^0_{r1}\right]\left\{1 - \frac{\beta_A\beta_F\Delta\pi_{r-1}}{c}\theta(1-\theta)\right\} > 0,$$

because $\frac{\beta_F\Delta\pi_{r-1}}{c} < 1$ due to Assumption 1, $\theta(1-\theta) < 1$ because $\theta < 1$, and $\beta_A < 1$.■

Proof of Proposition 15:

First, from (38), if the social returns to reputation are positive, then $\frac{\partial\widehat{\Psi}_r(p,q)}{\partial q} < 0$ and thus

$$\widehat{\Psi}_r(p^0_{r1}, 0) > \widehat{\Psi}_r(p^0_{r1}, q^*_{r1}). \tag{46}$$

Now, $\frac{\partial\widehat{\Psi}_r(p,q)}{\partial p} < 0$ for all (p,q) such that $p > \frac{\omega}{c} + \frac{\beta_F\left[(1-q)\Theta^0_{r2}+q\Theta^0_{r-1,2}\right]}{c}$. The condition $p^0_{r1} > \frac{\omega}{c} + \frac{\beta_F}{c}\max\left\{\Theta^0_{r-1,2}, \Theta^0_{r-1,2}\right\}$ implies $p^0_{r1} > \frac{\omega}{c} + \frac{\beta_F\left[(1-q)\Theta^0_{r2}+q\Theta^0_{r-1,2}\right]}{c}$ for all $q \in [0,1]$. Thus, $\frac{\partial\widehat{\Psi}_r(p,q)}{\partial p} < 0$ for any $p \geq p^0_{r1}$ which includes $p = p^*_{r1}$, and so

$$\widehat{\Psi}_r(p^0_{r1}, q^*_{r1}) > \widehat{\Psi}_r(p^*_{r1}, q^*_{r1}). \tag{47}$$

Given (46) and (47), $\Delta W^{*0}_r < 0$.■

Proof of Proposition 16:

First, given the condition in the proposition, we have

$$\gamma < \beta_F\min\left\{-\Theta^0_{r-1,2}, -\Theta^0_{r2}\right\} < \beta_F\left[p\left(-\Theta^0_{r2}\right) + (1-p)\left(-\Theta^0_{r-1,2}\right)\right] = -\beta_F\left[p\Theta^0_{r2} + (1-p)\Theta^0_{r-1,2}\right]$$

for any $p \in [0,1]$. From (38) it follows that $\frac{\partial\widehat{\Psi}_r(p,q)}{\partial q} > 0$ for all $(p,q) \in [0,1]\times[0,1]$. Thus

$$\widehat{\Psi}_r(p^*_{r1}, q^*_{r1}) > \widehat{\Psi}_r(p^*_{r1}, 0). \tag{48}$$

Now, $p^*_{r1} = p^{\mathcal{R}}_{r1}(q^*_{r1}) = (1-q^*_{r1})p^0_{r1} + q^*_{r1}p^0_{r-1,1}$ (using (17)) and since $p^0_{r1} < p^0_{r-1,1}$, it follows that $p^*_{r1} \leq p^0_{r-1,1}$. Now, given the condition of the proposition $p^0_{r-1,1} < \frac{\omega}{c} + \frac{\beta_F\min\{\Theta^0_{r-1,2},\Theta^0_{r2}\}}{c}$, then since $\min\{\Theta^0_{r-1,2}, \Theta^0_{r2}\} \leq (1-q)\Theta^0_{r2} + q\Theta^0_{r-1,2}$, it follows that $p^0_{r-1,1} < \frac{\omega}{c} + \frac{\beta_F\left[(1-q)\Theta^0_{r2}+q\Theta^0_{r-1,2}\right]}{c}$ for any $q \in [0,1]$,and thus, too, $p^0_{r1} < \frac{\beta_F\left[(1-q)\Theta^0_{r2}+q\Theta^0_{r-1,2}\right]}{c}$ for any $q \in [0,1]$. This establishes that both (p^*_{r1}, q^*_{r1}) and $(p^0_{r1}, 0)$ are from the part of (p,q) space over which $\frac{\partial\widehat{\Psi}_r(p,q)}{\partial p} > 0$. With $p^*_{r1} > p^0_{r1}$It therefore follows that

$$\widehat{\Psi}_r(p^*_{r1}, 0) > \widehat{\Psi}_r(p^0_{r1}, 0). \tag{49}$$

Given (48) and (49), $\Delta W^{*0}_r > 0$.■

Proof of Proposition 17:

When the activist is strong, we have $q^*_{r1} \approx 1$, and from the discussion above, $h^*_{ur} - h^0_{ur} < 0$. Moreover, $h^*_{dr} = (1 - p^*_{r1}) > 0$ because from (17), $p^*_{r1} \in (p^0_{r1}, p^0_{r-1,1}) < 1$. Because (33) holds, we have $\Theta^0_{r2} < 0$ and $\Theta^0_{r-1,2} < 0$. The second line of (30) are thus positive.

Now, note that (33) implies

$$\frac{\omega}{c} > \frac{(1+\beta_F)(1+\eta)}{\beta_F\,(1-\theta)} - (\frac{1}{2}+\eta)\,(1+\theta)\,\frac{\beta_F\theta\Delta\pi_{r-1}}{c}$$

which can be rewritten as

$$\frac{\omega}{c} > \frac{(1+\eta)}{(1-\theta)}\left[\frac{1}{\beta_F} + 1 - \frac{(\frac{1}{2}+\eta)\left(1-\theta^2\right)}{(1+\eta)}\frac{\beta_F\theta\Delta\pi_{r-1}}{c}\right]$$

Since $\frac{\beta_F\theta\Delta\pi_{r-1}}{c} < 1$, the term in brackets is greater than one and so $\frac{\omega}{c} > \frac{(1+\eta)}{(1-\theta)} > 1$. This implies that $\omega p - \frac{c}{2}p^2$ is strictly increasing for all $p \in [0,1]$, and because $p^*_{r1} > p^0_{r1}$, it follows that $\left[w(p^*_{r1}) - \frac{c}{2}\left(p^*_{r1}\right)^2\right] > \left[w(p^0_{r1}) - \frac{c}{2}\left(p^0_{r1}\right)^2\right]$, which establishes that the first line of ΔW^{*0}_r is positive. If γ is positive but sufficiently close to zero, then $\Delta W^{*0}_r > 0$.■

Proof of Proposition 18:

As before, with a strong activist, $h^*_{ur} - h^0_{ur} < 0$ and $h^*_{dr} > 0$. Given $\Theta^0_{r2} > 0$ and $\Theta^0_{r-1,2} > 0$, the middle line in the expression for ΔW^{*0}_r is negative. Since $p^S < p^0_{r+1,2}$ by the assumption of the proposition, $w(p) - \frac{c}{2}p^2 = \omega p - \frac{c}{2}p^2$ is strictly decreasing for $p \in [p^0_{r+1,2}, 1]$. Given earlier results that $p^0_{r+1,2} < p^0_{r2} < p^0_{r1} < p^*_{r1}$, it then follows that $w(p^*_{r1}) - \frac{c}{2}\left(p^*_{r1}\right)^2 < w(p^0_{r1}) - \frac{c}{2}\left(p^0_{r1}\right)^2$.■

Proof of Proposition 19

If the social returns to corporate reputation are negative, then as shown in the proof of Proposition 17, $\frac{\omega}{c} > 1$. Thus, $\omega - cp^0_{r1} > 0$, making the first term in (41) positive (recalling $p^0_{r-1,1} > p^0_{r1}$). The last term is positive, since, by assumption, $\Theta^0_{r-1,2} < 0$. The middle term is positive since $\Theta^0_{r2} < 0$ and as just discussed, $p^0_{r-1,1} - 2p^0_{r1} < 0$ if the term in (42) is negative. Thus, $\Psi'_r(0) > 0$ and a weak activist's presence increases social welfare.■

Proof of Proposition 20

If the social returns to corporate reputation are positive, $\Theta^0_{r-1,2} > 0$ and the last term in (41) is negative. The middle term is also negative since $\Theta^0_{r2} > 0$ and $p^0_{r-1,1} - 2p^0_{r1} < 0$ since the term in (42) is negative. Finally, given $\omega < \beta_F \Delta\pi_{r+1}$, it follows (as shown in the proof of Proposition 18) that $\omega - cp^0_{r1} < 0$, so the firm term in (41) is negative. Hence, $\Psi'_r(0) < 0$ and a weak activist's presence decreases social welfare.■

Proof of Proposition 21:

Evaluating $\Psi(1) - \Psi(0)$ gives us

$$-\beta_F \left[(1 - p^0_{r1}) + \theta p^0_{r1}\right] \Theta^0_{r-1,2} - \gamma < 0$$

because, given that (43), $\Theta^0_{r-1,2} > 0$.■

6.2 First-best social welfare

The maximal level of social welfare is attained in the solution to the problem of a social planner that chooses private regulation and campaign intensity to maximize social welfare. We can formulate the planner's problem as a dynamic program:

$$W^F_{rt} = \max_{p,q} \pi_r + \sigma + \omega p - \frac{c}{2}p^2 - \frac{\gamma q^2}{2} + \beta_F W^F_{r,t+1} + \beta_F \left[\begin{array}{c} W^F_{r+1,t+1} \\ -W^F_{r,t+1} \end{array}\right] p(1-q) + \beta_F \left[\begin{array}{c} W^F_{r-1,t+1} \\ -W^F_{r,t+1} \end{array}\right] (1-p)q,$$

for $r \in \mathcal{I}$ and $t = 1, 2, 3$, where the superscript P denotes the first-best solution. To analyze this problem, we work backward, let:

- *Period 3*: Because $W^F_{r4} = 0$ for $r \in \mathcal{I}$, the planner's optimal solution is $q^F_3 = 0$, and the first-best abatement effort maximizes the static net benefit from private regulation, i.e., $p^F_{r3} = p^S > p^0_{r3} = 0$. Abatement in the no-activist equilibrium is thus less than the first-best level, reflecting the classic textbook externality problem that arises in the terminal period. The third-period welfare level is

$$W^F_{r3} = \pi_r + \sigma_r + \omega p^S - \frac{c}{2}\left(p^S\right)^2,$$

so that

$$\Delta W^F_{r3} = \Delta\pi_r + \Delta\sigma_r$$

- *Period 2*: The planner's problem in state r of period 2 is now

$$W^F_{r2} = \max_{p,q} \pi_r + \sigma_r + \omega p - \frac{c}{2}p^2 - \frac{\gamma q^2}{2} + \beta_F W^F_{r3} + \beta_F \Delta W^F_{r3} p(1-q) - \beta_F \Delta W^F_{r-1,3}(1-p)q.$$

Because $\Delta W^F_{r3} > 0$ and $\Delta W^F_{r-1,3} > 0$, the objective function is clearly decreasing in q, so $q^F_3 = 0$, which reduces the planner's problem to

$$W^F_{r2} = \max_{p,q} \pi_r + \sigma_r + \omega p - \frac{c}{2}p^2 + \beta_F W^F_{r3} + \beta_F \Delta W^F_{r3} p,$$

which implies that p^F_{r2} is given by:

$$p^F_{r2} = \min\left\{\frac{\omega + \beta_F \Delta W^F_{r3}}{c}, 1\right\} = \min\left\{\frac{\omega + \beta_F \left[\Delta\pi_r + \Delta\sigma_r\right]}{c}, 1\right\}.$$

Note that $\frac{\omega+\beta_F[\Delta\pi_r+\Delta\sigma_r]}{c} > \frac{\beta_F \Delta\pi_r}{c} = p^0_{r2}$. It is straightforward to verify that $p^F_{r2} > p^0_{r2}$, i.e., private regulation in the no-activist equilibrium is less than first best.[27] The second-period welfare level in state r is thus

$$W^F_{r2} = (1+\beta_F)\left[\pi_r + \sigma_r\right] + \beta_F\left[\omega p^S - \frac{c}{2}\left(p^S\right)^2\right] + \left(\omega + \beta_F\left[\Delta\pi_r + \Delta\sigma_r\right]\right) p^F_{r2} - \frac{c}{2}\left(p^F_{r2}\right)^2,$$

which implies

$$\Delta W^F_{r2} = \begin{cases} \left[\Delta\pi_r + \Delta\sigma_r\right] + \beta_F\left[\Delta\pi_{r+1} + \Delta\sigma_{r+1}\right] & p^F_{r+1,2} = p^F_{r2} = 1 \\ (1+\beta_F)\left[\Delta\pi_r + \Delta\sigma_r\right] + \begin{bmatrix} \left\{\frac{(\omega+\beta_F[\Delta\pi_{r+1}+\Delta\sigma_{r+1}])^2}{2c}\right\} \\ -\left\{(\omega + \beta_F\left[\Delta\pi_r + \Delta\sigma_r\right]) - \frac{c}{2}\right\} \end{bmatrix} & p^F_{r+1,2} < p^F_{r2} = 1 \\ (1+\beta_F)\left[\Delta\pi_r + \Delta\sigma_r\right] + \frac{1}{2c}\begin{bmatrix} (\omega + \beta_F\left[\Delta\pi_{r+1} + \Delta\sigma_{r+1}\right])^2 \\ -(\omega + \beta_F\left[\Delta\pi_r + \Delta\sigma_r\right])^2 \end{bmatrix} & p^F_{r+1,2} < p^F_{r2} < 1 \end{cases}.$$

Clearly, when $p^F_{r+1,2} = p^F_{r2} = 1$, we have $\Delta W^F_{r2} > 0$. When $p^F_{r+1,2} < p^F_{r2} = 1$,[28]

$$\begin{aligned} \Delta W^F_{r2} &> (1+\beta_F)\left[\Delta\pi_r + \Delta\sigma_r\right] + \left\{(\omega + \beta_F\left[\Delta\pi_{r+1} + \Delta\sigma_{r+1}\right]) - \frac{c}{2}\right\} - \left\{(\omega + \beta_F\left[\Delta\pi_r + \Delta\sigma_r\right]) - \frac{c}{2}\right\} \\ &= \left[\Delta\pi_r + \Delta\sigma_r\right] + \beta_F\left[\Delta\pi_{r+1} + \Delta\sigma_{r+1}\right] > 0. \end{aligned}$$

For the case of an interior solution, which requires $\frac{\omega+\beta_F[\Delta\pi_r+\Delta\sigma_r]}{c} < 1$, we have (after some algebra)

$$\begin{aligned} \Delta W^F_{r2} &= \Delta\pi_r + \Delta\sigma_r + \beta_F\left\{\begin{array}{c} 1- \\ \frac{2\omega+\beta_F\{[\Delta\pi_{r+1}+\Delta\sigma_{r+1}]+[\Delta\pi_r+\Delta\sigma_r]\}}{2c} \end{array}\right\}\left[\Delta\pi_r + \Delta\sigma_r\right] \\ &\quad +\beta_F\left\{\frac{2\omega + \beta_F\left\{\left[\Delta\pi_{r+1} + \Delta\sigma_{r+1}\right] + \left[\Delta\pi_r + \Delta\sigma_r\right]\right\}}{2c}\right\}\left[\Delta\pi_{r+1} + \Delta\sigma_{r+1}\right], \end{aligned} \tag{50}$$

[27] There are two possible cases: if $p^P_{r2} = \frac{\omega+\beta_F[\Delta\pi_r+\Delta\sigma_r]}{c}$, then as just shown $p^P_{r2} = \frac{\omega+\beta_F[\Delta\pi_r+\Delta\sigma_r]}{c} > p^0_{r2}$; if $p^P_{r2} = 1$, then $p^P_{r2} > p^0_{r2}$ because p^0_{r2} Assumption 1 implies $p^0_{r2} < 1$. Thus, $p^P_{r2} > p^0_{r2}$.

[28] Let $x = \omega + \beta_F\left[\Delta\pi_{r+1} + \Delta\sigma_{r+1}\right]$. The first line then follows from

$$\begin{aligned} 0 &< (x-c)^2 \\ &= x^2 - 2xc + c^2 \\ &= \frac{x^2}{2c} - \left(x - \frac{c}{2}\right). \end{aligned}$$

In this case, $\frac{\omega+\beta_F[\Delta\pi_{r+1}+\Delta\sigma_{r+1}]}{c} < \frac{\omega+\beta_F[\Delta\pi_r+\Delta\sigma_r]}{c} < 1$, so $1 - \frac{2\omega+\beta_F\{[\Delta\pi_{r+1}+\Delta\sigma_{r+1}]+[\Delta\pi_r+\Delta\sigma_r]\}}{2c} > 0$, and $\Delta W^F_{r2} > 0$.

- *Period 1*: The planner's problem in state r of period 1 is

$$W^F_{r1} = \max_{p,q} \pi_r + \sigma_r + \omega p - \frac{c}{2}p^2 - \frac{\gamma q^2}{2} + \beta_F W^F_{r2} + \beta_F \Delta W^F_{r2} p(1-q) - \beta_F \Delta W^F_{r-1,2}(1-p)q,$$

and because $\Delta W^F_{r2} > 0$ and $\Delta W^F_{r-1,2} > 0$, we have $q^F_1 = 0$. As in the second-period then, the planner's problem reduces to

$$W^F_{r1} = \max_{p} \pi_r + \sigma_r + \omega p - \frac{c}{2}p^2 + \beta_F W^F_{r2} + \beta_F \Delta W^F_{r2} p,$$

which implies that p^F_{r1} is given by:

$$p^F_{r1} = \min\left\{\frac{\omega + \beta_F \Delta W^F_{r2}}{c}, 1\right\}.$$

Now recall that in the no-activist equilibrium private regulation is given by $p^0_{r1} = \frac{\beta_F \Delta u^0_{r2}}{c}$, where using (44),

$$\Delta u^0_{r2} = \Delta\pi_r + \beta_F \left[\left(1 - \frac{\beta_F [\Delta\pi_{r+1} + \Delta\pi_r]}{2c}\right)\Delta\pi_r + \frac{\beta_F [\Delta\pi_{r+1} + \Delta\pi_r]}{2c}\Delta\pi_{r+1}\right].$$

[MA: The last inequality `<now deleted>` **is false. Suppose it's true hence $\Delta\pi_r + \beta_F\Delta\pi_{r+1} > \Delta u^0_{r2}$. This is equivalent to $\Delta\pi_{r+1} > (1-\alpha)\Delta\pi_r + \alpha\Delta\pi_{r+1}$, where $\alpha = \frac{\beta_F[\Delta\pi_{r+1}+\Delta\pi_r]}{2c} \in (0,1)$. But $\Delta\pi_r > \Delta\pi_{r+1}$ by DSRR, hence a contradiction.** `DB: Yes. I have changed the proof. This part was not necessary anyway, as can be seen from the following revision`] To compare p^0_{r1} to the first-best abatement level p^F_{r1}, suppose that we have an interior solution in period 1. (In the case of a corner solution, $p^F_{r1} = 1 > p^0_{r1}$.) Substitute $\Delta\sigma_r = \eta\Delta\pi_r$ (where, recall, $\eta > 0$) into (50) to get

$$\Delta W^F_{r2} = (1+\eta)\left\{\Delta u^0_{r2} - \beta_F\left(\frac{\omega}{c} + \frac{\eta\beta_F [\Delta\pi_{r+1} + \Delta\pi_r]}{2c}\right)[\Delta\pi_r - \Delta\pi_{r+1}]\right\}.$$

Thus

$$p^F_{r1} = \frac{\omega}{c} + \frac{\beta_F}{c}(1+\eta)\left\{\Delta u^0_{r2} - \beta_F\left(\frac{\omega}{c} + \frac{\eta\beta_F [\Delta\pi_{r+1} + \Delta\pi_r]}{2c}\right)[\Delta\pi_r - \Delta\pi_{r+1}]\right\}.$$

When $\eta = \omega = 0$, $p_{r1}^F = p_{r1}^0$, i.e., when there are no externalities, we get the no-activist equilibrium level of private regulation. If $\eta = 0$ but $\omega > 0$, we get

$$\begin{aligned} p_{r1}^F &= \frac{\beta_F \Delta u_{r2}^0}{c} + \frac{\omega}{c}\left[1 - \frac{\beta_F^2 \Delta \pi_r}{c} + \frac{\beta_F^2 \Delta \pi_{r+1}}{c}\right] \\ &= p_{r1}^0 + \frac{\omega}{c}\left[1 - \beta_F p_{r2}^0 + \beta_F p_{r+1,2}^0\right] > p_{r1}^0. \end{aligned}$$

In fact,

$$\frac{\partial p_{r1}^F}{\partial \omega} = \frac{1}{c}\left[1 - \frac{\beta_F^2\left[\Delta \pi_r - \Delta \pi_{r+1}\right]}{c}(1+\eta)\right]$$

$\frac{\partial p_{r1}^F}{\partial \omega} > 0$ (and thus $p_{r1}^F > p_{r1}^0$) if and only if $1 - \frac{\beta_F^2[\Delta\pi_r - \Delta\pi_{r+1}]}{c}(1+\eta) > 0$ or

$$\eta < \frac{1}{\beta_F\left[p_{r2}^0 - p_{r+1,2}^0\right]} - 1$$

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