# Citizen suits and reputation costs in a model of limited enforcement and endogenous regulatory strategy

by

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# Contents

# 1 Introduction

Over the course of the last forty years the evolution of environmental law in the United States has promoted and facilitated the establishment of a legal space in which a citizen's group[1] can initiate civil law actions, or citizen suits,[2] to ensure that environmental laws are properly enforced against polluters. Citizen suits are increasingly prominent in environmental jurisprudence. The success that citizen suits have had in the past has encouraged a growing socio-legal awareness of their effectiveness in protecting the environment. Furthermore, the number of citizen suits are expected to rise in the future driven by continued government underfunding of environmental protection agencies, and the development of legal mechanisms that permit plaintiffs to recover a portion of their legal expenses following a successful suit (Naysnerski and Tietenberg, 1992; Settle et. al, 2001, Macfarlane and Terry, 1997).

There are two potential sources of incentives for polluting industries to comply with environmental laws. Citizen suits are private sources while a government regulator is a public source. Private and public sources of compliance incentives are substitutes. Provision of these compliance incentives is therefore inter-related.

The responsibility to enforce environmental laws is typically the domain of a government environmental regulatory agency. To ensure polluters obey environmental laws, the regulator must provide polluters with compliance incentives. Compliance incentives generally take the form of financial penalties for noncompliance. Complete enforcement of environmental laws is generally unattainable and would be undoubtedly inefficient if it were possible.[3] Many factors constrain a regulator's operations and contribute to its failure

[1] This term refers to an amalgam of concerned citizens and environmental non-governmental organizations.

[2] In this essay the term 'citizen suit' encompasses *de jure* and *de facto* citizen suits. In *de jure* civil actions, the plaintiff establishes their standing in court by refering to specific citizen suit provisions in environment law statutes. For example, citizen suit provisions are included in the Clean Air Act and the Clean Water Act, as well as many other environmental statutes and regulations. In *de facto* civil actions, the plaintiff establishes their standing in court by other legal arguments, whether because it is expedient to do so or because under the circumstances or jurisdiction in question there are no citizen suit provisions to which the plaintiff has recourse. Thus, while the difference between the two is one of the statutory foundation for subsequent legal argumentation, the similarity is the intent of the plaintiff to ensure that environmental laws are enforced in order to prevent or reduce environmental degradation.

[3] Becker (1968) is responsible for the seminal contribution to the economic approach to law enforcement.

or inability to provide sufficient compliance incentives. Factors include a limited budget and an insufficient number of adequately trained inspection agents, insufficient information about the activities of polluters and the nature of pollutants released into the environment, and political pressures requiring that business and economic imperatives take priority over environmental quality (Langpap, 2007).

Citizen suits against a polluting industry can also provide polluters with compliance incentives. Citizen suits require industry to incur costly legal expenses. Moreover, citizen suits could damage the industry's reputation leading to a reduction in demand for the industrial product itself, further lowering industrial profits. If the threat of citizen suits is credible, the industry will have the incentive *ex ante* to undertake greater pollution abatement effort and reduce the extent to which it is in noncompliance with environmental laws. However, the extent to which citizen suits are credible depends not only on the resources at the disposal of the plaintiffs but also on the socio-legal institutional factors that shape the plaintiffs' incentives for initiating citizen suits. For example, federal and provincial statutes in Canada contain citizen suit provisions similar to those found in the U.S.[4] However, the contribution of these provisions to environmental protection in Canada has been minimal. Factors explaining this include, amongst others, the high cost of litigation that dissuades citizen suits, low prescribed penalties for convicted violators of environmental laws, and the absence of political and legal support for citizen suits (Boyd, 2003, 267-272).

Instead of targeting the polluting industry, citizen suits can target the regulator. In this case the plaintiffs argue that the regulator is not fulfilling its responsibilities with respect to the regulation of polluting industries.[5] There have been several citizen suits of this type in Canada in the last decade, of which I will briefly mention four that are particularly relevant in the context of this essay: *R. v. Kingston (Corp. of the City)* [2004][6],

[4]For example, the Canadian Environmental Protection Act, 1999, and the Ontario Environmental Bill of Rights.

[5]Here the term regulator refers to the capacity of a government agency to monitor and control the behaviour of a person or incorporation that engages in an activity that legally warrants such government intervention.

[6]Electronic database source: *R. v. Kingston (Corp. of the City)*, 2004, CanLII 39042 (ON C.A.).

*Lukasik v. Hamilton (City)* [1998][7], *Pearson v. Inco Ltd.* [2006][8], and *Talbot v. Northwest Territories (Commissioner)* [1997][9].

*Pearson v. Inco Ltd.* is an archetypal example of a citizen suit against a regulator for failing to enforce environmental laws. The plaintiff, Wilfred Pearson, applied to the court to certify his action as a class proceeding to sue the Provincial crown, the Regional Municipality of Niagara as well as the City of Port Colborne for failing to enforce the Ontario Environmental Protection Act with respect to the regulation of a local Inco metal refinery.[10] The plaintiff alleged that the refinery's emissions of hazardous substances had reduced the property value of Port Colborne residents in addition to inflicting harm to residents' health. On November 18, 2005, the Ontario Court of Appeal upheld a lower court's dismissal of the plaintiff's action for a number of reasons, most notably for failing to disclose reasonable cause of action against the defendants. In particular, the court concluded that since the province had discretion to exercise its statutory power to regulate the activity of the metal refinery the non-exercise of this discretionary power could not give rise to a negligence claim against the province – the province was under no obligation and had no statutory duty to exercise its regulatory authority.

*R. v. Kingston (Corp. of the City)* and *Lukasik v. Hamilton (City)* are remarkably similar case studies of citizen suits against municipal government authorities. In *R. v. Kingston*, the plaintiff, Janet Fletcher accused the City of Kingston of violating the Fisheries Act by depositing deleterious substances into the Great Cataraqui River. [11] On May 12, 2004, the Ontario Court of Appeal upheld the majority of the charges laid against the city and ordered the city to pay a fine of $30,000. In *Lukasik v. Hamilton (City)*, the plaintiff, Lynda Lukasik, accused the City of Hamilton of the same violation of the Fisheries Act as

[7]The precise name of the court case is unknown. The record of the court's decision was not available through electronic media. Instead, I based the description of the decision on a private environmental investigation firm's news releases located at http://www.e-b-i.net/ebi/weprosecute.html., last accessed on November 8, 2008.

[8]Electronic database source: *Pearson v. Inco Ltd., et al.*, 2006, CanLII 913 (ON C.A.).

[9]Electronic database source: *Talbot v. Northwest Territories (Commissioner)*, 1997, CanLII, 4520 (NWT S.C.).

[10]Inco was also named as a defendant in the citizen suit.

[11]The deleterious substances originated from the site of a former municipal dump that had been transformed into a golf course and city park. Janet Fletcher brought charges against the city after conducting water samples that indicated the presence of toxins including high concentrations of ammonia. The Ontario Ministry of the Environment later brought additional charges against the city under the Ontario Water Resources Act.

the City of Kingston in *R. v. Kingston*.[12] The city pleaded guilty to the charges and on September 18, 2000, the city was ordered to pay $450,000 in fines, one of the heaviest ever levied against a Canadian municipality for violating environmental laws.

*Talbot v. Northwest Territories (Commissioner)* is similar in some respects to *Pearson*, *R. v. Kingston*, and *Lukasik*. The plaintiff, David Talbot, accused various elected officials from the governments of the Northwest Territories and Canada of negligence in exercising regulatory authority for permitting high concentrations of arsenic from mining activity to leak into Great Slave Lake. As in *R. v. Kingston* and *Lukasik*, control of the identified toxic substance was argued to be the responsibility of a public authority. As in *Pearson*, the plaintiff argued that the defendants, representatives of public authorities, had failed to take the necessary steps to stem the escape of the toxic substance, damaging the personal health and private property of others. On November 21, 1997, the court struck out the plaintiff's statement of claim ruling that the plaintiff did not have standing to bring suit.

Common to each of these court decisions is that the plaintiff is a citizen who names a government agency or representative thereof in a private enforcement action. *Pearson* and *Talbot* are excellent examples of citizen suits in which the plaintiff alleges the government failed to regulate a polluting industry in accordance with environmental laws. *R. v. Kingston* and *Lukasik* are good examples of citizen suits in which the government is accused of violating its own environmental laws. The only difference between *Pearson* and *Talbot* and the other two cases is the institutional proximity of the alleged violator of the environmental laws to the regulating authority. In *Pearson* and *Talbot*, the alleged violator is a regulated polluting industry, while in *Lukasik* and *R. v. Kingston*, the alleged violator and the regulator are both public authorities. All four cases highlight the public policy relevance of studying the implications of citizen suits targeting public authorities. However, the case law of these court decisions suggests that there is little scope for private enforcement actions against regulatory failure.

Only a small part of the economic and environmental consequences that emerge

[12] On several occasions, the City of Hamilton discharged PCB and ammonia toxins into the Red Hill Creek from a public works yard. As in *R. v. Kingston (Corp. of the City)*, the Ontario Ministry of the Environment also brought additional charges against the city under the Ontario Water Resources Act.

from citizen suits against regulators can be inferred directly from court decisions. Citizen suits against regulators have the potential to change regulators and polluters incentives. On the one hand, successful citizen suits can have positive spillover effects with respect to environmental quality. By holding the regulator accountable for its law enforcement activities in a court of law and in the domain of public opinion, citizen suits can shame or goad a regulator into improving its regulatory strategy.[13] However, citizen suits also leave the regulator with less of a budget to allocate to monitoring and enforcement activity and therefore reduce the regulator's capacity to provide polluters with compliance incentives.

On the other hand, regardless of the success of citizen suits against the regulator, the proceedings of the trial have the potential to damage the reputation of the regulated industry. Reputation is an invaluable intangible asset and citizen suits that publicize information about a polluting industry's behaviour can be prejudicial to that asset. Faced with this prospect, a polluting industry may take preventative action to lower expected reputation costs from citizen suits by *ex ante* reducing its level of noncompliance with environmental laws. In the absence of reputation effects, the industry does not suffer reputation costs, and moreover, it reacts to the change in regulatory strategy by increasing its level of noncompliance.

This essay extends the regulatory enforcement model of Garvie and Keeler (1994) by adding a fourth player, citizen's groups, that initiate citizen suits against the regulator.[14] This essay further extends the standard model of a regulator with incomplete enforcement power and endogenous regulatory choice by including reputation costs as a negative externality that the industry experiences as a result of citizen suits.

The essay is organized as follows. In Section 2, the review of the literature is organized into two parts. The first part briefly reviews the structure of standard regulatory

[13] A recent prominent example of this is *Massachusetts et al. v. Environmental Protection Agency et al.* [2007] in which thirteen environmental groups joined Massachusetts and eleven other states as appellants to petition the federal evironmental law enforcement authority to regulate greenhouse gas emissions. On April 2, 2007 the U.S. Supreme Court ruled that the EPA has the authority to regulate greenhouse gases and cannot dispense itself of this authority without providing scientifically-based arguments. (See the syllabus of the Supreme Court's ruling available online at *www.supremecourtus.gov/opinions/*06*pdf/*05 − 1120*.pdf* or the *New York Times* news article of April 2, 2007 available online at *www.nytimes.com*/2007/04/03/*washington*/03*scotus.html*).

[14] The citizen's group is modeled as a non-strategic player as I am solely interested in understanding the consequences of a citizen suit. In this essay I abstract from legal issues and jurisprudence in order to simplify the treatment of the topic.

enforcement models found in the literature, that is, those models that do not account for citizen's groups. The second part briefly examines the literature that incorporates citizen's groups in regulatory enforcement models. In Section 3, I present a model of a regulatory enforcement game. A general model and two special cases are formally analyzed to show the impact of citizen suits without the presence of reputation effects and the impact of reputation effects given citizen suits. In the final section, I conclude with a consideration of the policy implications of this model.

# 2 Review of Literature

The literature review is divided into two sections. The first presents the structure of standard regulatory enforcement models that feature a regulator and regulated firms.[15] The second section reviews studies that adopt or propose models that augment the standard regulatory enforcement model with citizen's groups that are empowered to launch citizen suits.[16]

## 2.1 Structure of Standard Regulatory Enforcement Models

The most relevant models in the enforcement literature are game theoretic in nature. Game theoretic modeling provides a natural framework for studying economic behaviour in the regulatory strategy setting. The regulator and the firm are the two archetypal players in the regulatory strategy game. Each has their own objectives and constraints, and each is aware that the behaviour of the other impacts the attainment of their own goals. What emerges is a strategic game in which each player seeks to rationally make the best possible decision in reaction to any possible action that the other player takes. Static models, in contrast, fail to capture the strategic interaction of the regulator and the firm.

The firm is the generic name of the economic agent that produces goods or services and an undesirable by-product, pollution. The consensus in the literature is to model the firm's decision problem as that of choosing pollution abatement activity to minimize expected total compliance costs (for example, Harrington, 1988; Kambhu, 1989; Malik, 1993; Garvie and Keeler, 1994; Livernois and McKenna, 1999). Expected total costs are the sum of the costs of undertaking pollution abatement activity and the expected costs of not undertaking sufficient abatement activity to be in compliance with environmental laws. A rational firm chooses a level of abatement activity such that the marginal cost of complying with environmental laws equals the expected marginal costs of not complying

[15] A brief note on terminology. The literature typically identifies the regulated community as consisting of 'firms'. I identify this community as an 'industry', abstracting from the individual firms that compose it in reality. More on this in section 3.

[16] A comparison and contrast of the first set of models is important for understanding the way in which models similar to that of Garvie and Keeler (1994) are constructed. Although the findings of these studies are interesting in their own right, they are not discussed because they do not contribute to a better understanding of how I intend to the extend of the model of Garvie and Keeler (1994).

with these laws.[17] The expected marginal cost of noncompliance is the product of the risk of being caught breaking the law and the marginal fines, penalties, or sanctions that a regulator or the court imposes on the noncompliant firm.[18] A rational firm recognizes and acts upon the incentive to undertake less abatement activity when the expected marginal punishment for noncompliance is lower. For example, when there is a reduced chance of being caught or when the marginal fine is less severe.

In the simplest game theoretic model all firms are homogeneous and pollution is deterministic. This implies identical behaviour among all firms and no uncertainty as to how much pollution occurs. More complex models account for firm heterogeneity or multiple states of the world in which pollution is a function of a stochastic variable. For example, Harrington (1988) models firms that experience differential treatment at the hands of the regulator depending upon the firms' behaviour in the previous period. Malik (1993) models states of the world in which firms produce high versus low levels of stochastically occuring pollution. Garvie and Keeler (1994) model low-cost versus high-cost firms and characterize an equilibrium regulatory strategy that discriminates between the two.

It is a convention in the literature for there to be a single regulator that the government mandates to enforce environmental laws.[19] The implication is that no other economic agent is permitted to enforce environmental laws. The regulator is assumed to be benevolent, acting in the best interest of society. Furthermore, the regulator has a limited budget that constrains its capacity to carry out its operations.[20] Consequently, the regulator cannot monitor all polluters and the complete enforcement of environmental laws is impossible.

The regulator's decision problem is how to most efficiently engage in regulatory activities pursuant to its objective or mandate. However, unlike the firm's decision problem, there is little consensus regarding the objective function of the regulator. There are four

[17] In the litigation literature, the influential studies of Shavell (1982b, 1999) models the analogous situation in which an economic agent that is liable for harm caused to a third-party chooses a level of care in order to minimize total costs of exercising that care and the expected cost of damages to the third-party.

[18] Kambhu (1989) models a firm that chooses rent-seeking activity and pollution abatement activity to minimize total compliance costs. In the model, a firm expends resources on legal activities to avoid incurring penalties imposed by a regulator. The structure of the model drives the firm to substitute rent-seeking activities for abatement activities when the exogeneously determined regulatory standard is raised above a critical threshold.

[19] The exception being, as is the case in this essay, when private enforcement actions are modeled.

[20] As in Garvie and Keeler (1994) but unlike Langpap (2007).

distinct regulator objective functions modeled in the literature: maximization of firms' compliance with environmental laws (Raymond, 2004), and its equivalent dual, minimization of firms' noncompliance (Garvie and Keeler, 1994); minimization of environmental damage (Heyes and Rickman, 1999); minimization of regulatory strategy costs (Harrington, 1988; Livernois and McKenna, 1999); minimization of expected social costs, consisting of the costs of implementing the regulatory strategy and the firms' abatement activity costs (Malik, 1993; Langpap, 2007).

Irrespective of the objective of the regulator the regulatory activities are commonly divided into monitoring and enforcement activities. Monitoring activities consist of inspection and verification to determine an industry's pollution level and whether it exceeds limits established by environmental laws. Enforcement activities consist of preparing evidence against the proportion of the industry monitored and the administrative and legal proceedings that are necessary to punish noncompliance in the form of fines, penalities as well as court-ordered sanctions. These activities are modeled in many different ways in the literature. With respect to monitoring activity, some studies model the regulator as establishing a single monitoring probability for inspecting firms (Livernois and McKenna, 1999), while others have heterogeneous monitoring probabilities when firms are heterogeneous (Garvie and Keeler, 1994) or when the monitoring probabilities are state-dependent (Harrington, 1988; Malik, 1993). As for enforcement activity, Langpap (2007) models the regulator as choosing a probability of punishing a non-compliant firm in contrast to the model of Garvie and Keeler (1994) in which enforcement activity is automatically undetaken against any firm found in noncompliance with environmental laws (Garvie and Keeler, 1994). In Livernois and McKenna (1999) and Langpap (2007) the regulator sets the fines contingent on whether or not the firm truthfully reported its level of compliance.[21]

There are several types of constraints that models impose on the regulator's choice of a regulatory strategy. One such constraint is a fixed budget for carrying out monitoring and enforcement activities (Garvie and Keeler, 1994). Another is performance standards that require a cost-minimizing regulator to achieve a given compliance rate (Harrington,

[21]In this essay I do not investigate how alternate assumptions about the modeling of the regulator's monitoring and enforcement activities, as briefly mentioned in this paragraph, affect the equilibrium results.

1988; Garvie and Keeler, 1994; Livernois and McKenna, 1999). Or the regulator is modeled as constrained to choose the regulatory strategy that induces deceptive or imperfectly monitored firms to truthfully self-report their compliance status (Livernois and McKenna, 1999 and Langpap, 2007). Lastly, among the possible constraints facing the regulator, the inclusion of the firms' anticipated reaction to any regulatory strategy – the regulatory reaction function (Garvie and Keeler, 1994; Raymond, 2004; and Langpap, 2007) – is not an institutional constraint per se, but instead reflects the strategic nature of the regulatory enforcement game and the timing of the players' interaction.

A game theoretic model in which the regulator acts as a leader and anticipates the reaction of firms is called a Stackelberg model.[22] In a Stackelberg model the regulator moves first by choosing its regulatory strategy and either knows the costs functions of the regulated firms (Garvie and Keeler, 1994; Langpap, 2007) or the distribution of the cost functions in the population of regulated firms (Raymond, 2004). This model highlights the importance of the timing with which the players move in a game theoretic model. All the studies surveyed at least implicitly assume that the regulatory strategy is common knowledge once announced and that the regulator commits to that regulatory strategy. The firm behaves as a follower and moves second, taking as given the regulatory strategy in calculating its abatement decision (Langpap, 2007) or the extent to which it breaks the law – its level of noncompliance (Garvie and Keeler, 1994).[23]

In the literature the judiciary is modeled as a technology that is integrated into the decision problems of the regulator and the firms. For example, in Garvie and Keeler (1994), the judiciary levies fines against convicted polluters as a function of the regulator's enforcement expenditures per non-compliant firms and the severity with which the firms break the law. This function includes a parameter that captures the willingness of the judiciary to rule against the accused polluters. The parameter also accounts for broader socio-legal considerations that are subject to temporal variation. Where structural param-

[22]The Stackelberg model is also pertinent for litigation games. For example, in Heyes (1997) and Settle, Hurley, and Shogren (2001), a citizen suit and a firm compete over the right to control environmental quality.

[23]This assumes the firm has perfect knowledge of the environmental laws and can perfectly control its pollution. Malik (1993) and Langpap (2007) relax this last condition. Both model pollution as a binary stochastic variable (i.e. low pollution and high pollution) with a known probability distribution that is positively related to a firm's pollution abatement actiivty.

eters change over time, the duration of a regulatory strategy game becomes an important part of a model. In contrast, in the models of Heyes and Rickman (1999) and Langpap (2007), the outcome of any case is a function of the expenditures of the litigating parties.

The are two general approaches for modeling the duration of a game in the enforcement literature: a single period game and a multi-period game. The multi-period model of Harrington (1988) captures the regulator's differential treatment of regulated firms. The dynamic model incorporates a firm's compliance record in the determination of the punishment that it incurs (Harrington, 1988, 31). In Livernois and McKenna (1999) pollution abatement equipment malfunctions with a known probability. In the case of malfunction, the firm remains non-compliant and at risk of detection until the malfunctioning equipment is repaired. The firm is therefore faced with an intertemporal decision problem as to when to repair the equipment. However, single-period games are modeled more frequently in the enforcement literature. A single-period model treats every game as a one-off event in which the players do not interact in later periods. Consequently, there is no intertemporal decision problem that requires the players to discount expected payoffs in the future from taking certain actions in the present.

## 2.2 Regulatory Enforcement Models with Citizen's Groups

A limited number of studies have built upon the structural foundations of standard regulatory enforcement models by incorporating citizen's groups as a non-strategic player.[24] In particular, Langpap (2007) incorporates a citizen's group (also known by the acronym CG) as a strategic player in a single-period regulatory enforcement game set in a Stackelberg model. In Langpap's model the CG can only launch a citizen's suit if the regulator chooses not to enforce environmental laws against a non-compliant firm. When the CG launches a citizen suit it chooses a level of legal expenditures in order to maximize its expected net payoff from launching a citizen suit against a non-compliant firm. In solving its decision

[24]Incidentally, in one of the first studies that considers the role of private enforcement actions, Cohen and Rubin (1985) propose the libertarian argument that citizen's groups be solely responsibility for enforcing environmental laws. This proposal is based on the arguments that because private parties have more of an incentive than public regulatory authorities to enforce laws efficiently social benefits would be greater. Heyes (1997) conducts a similar thought-experiment when studying the optimal subsidy-tax regime to achieve an optimal level of citizen suits.

problem, the firm accounts for the expected fine it will pay in the event that the CG chooses to enforce environmental laws when the regulator declines to do so. As the leader in the Stackelberg model, the regulator's decision problem includes the CG's optimal litigation expenditure decision[25] in addition to the firm's regulatory reaction function.

Langpap (2007) was preceeded by two other studies that conjecture as to the consequences of CG involvment in environmental law enforcement.[26] Naysnerski and Tientenberg (1992) and Heyes and Rickman (1999) offer opposing viewpoints on the consequences that citizen suits have on regulatory strategies and the protection of the environment. Naysnerski and Tientenberg (1992) are optimistic. Without formally presenting a model, they argue that private enforcement actions can be additive to and complement the operations of a regulator. In other words, CGs are a substitute for regulatory action. They predict superior environmental quality, higher compliance rates, and that the regulator allocates their limited enforcement budget more effectively as a result of private enforcement actions. These gains, however, are contingent on the cost to CGs of initiating citizen suits relative to the cost of a regulator-initiated enforcement action. If the former is less costly than the latter, Naysnerski and Tientenberg (1992) analysis implies that a citizen suit is equivalent in effect to a regulatory budget increase that allows the regulator to expand its influence over polluting firms. Underlying this analysis is the crucial assumption that the firm's incentives to not fully comply with environmental laws is identical whether the enforcer is the state or a CG.

Unlike Naysnerski and Tientenberg (1992), Heyes and Rickman (1999) are more hesitant to praise the virtues of the involvement of CGs in the enforcement of environmental laws. Heyes and Rickman stress that private enforcement actions may inadvertently impair the regulator's ability to efficiently implement its regulatory strategy. Their analysis highlights the distinction between compliance-oriented and deterrence-oriented regimes[27] and

[25] Consistent with the standard litigation model, the CG initiates a citizen suit if and only if the expected benefits exceed the expected costs of litigation (See, for example, Shavell, 1982a, 1982b, 1997; Kaplow, 1986).

[26] A number of studies, including Baik and Shogren (1994), Heyes (1997), and Settle, Hurley, and Shogren (2001), construct game theoretic models of the litigation conflict between citizen groups and firms. These models, not directly relevant to this essay, are concerned primarily with characterizing the efficient level of effort that each party expends under different circumstances in pursuit of a favourable verdict from the courts.

[27] The two poles of the continuum of regulatory regimes (Kagan, 1989)

the economic interpretation of both regimes under different parametric conditions as originally discussed in Garvie and Keeler (1994). A deterrence-oriented regulatory regime is a legalistic, sanction-oriented, and coercive style of regulation in which the regulator contends with an uncooperative or openly hostile regulated community. Violations are permitted little tolerance and are vigorously prosecuted (Kagan, 1989; Garvie and Keeler, 1994). A compliance-oriented regulatory regime is a conciliatory, accommodative style of regulating in which there is frequent contact between the regulator and the regulated industry. Noncompliance is more readily tolerated as the regulator encourages a cooperative exchange relationship with the regulated industry in order to achieve satisfactory results (Hawkins, 1983; Kagan, 1989; Garvie and Keeler, 1994).

Returning to the model of Heyes and Rickman (1999), the regulator uses its discretionary powers as part of its regulatory strategy to negotiate or tacitly permit firm noncompliance in one domain in exchange for firm compliance in another domain, as in the compliance-oriented regulatory regime. The regulator's equilibrium regulatory strategy establishes a set of incentives that efficiently induce firms to comply with environmental laws to a greater extent than if the regulator fully pursued violators, as in the deterrence-oriented regulatory regime. However, where CGs can initiate citizen suits despite the regulator's discretionary use of its powers, the intervention of CGs undermine these incentives.[28] Heyes and Rickman (1999) argue that by distorting the efficiency of the regulatory strategy a citizen suit reduces the leverage of the regulator's discretionary powers to negotiate higher compliance rates and therefore a deterioration in environmental quality must necessarily follow. As with Naysnerski and Tientenberg (1992), this assumes that the firm's noncompliance incentives are the same regardless of the identity of the law enforcer, which as the previous footnote makes reference, is an open question for investigation.

The model of Langpap (2007) formalizes the discussions of Naysnerski and Tientenberg (1992) and Heyes and Rickman (1999). Langpap found that a citizen suit can promote social efficiency gains if a CG has the incentive to engage in private enforcement actions

[28] Anecdotal evidence supports this hypothesis. Macfarlane and Terry (1997) report that with the rise of citizen suits in the U.S., firms increasingly prefer that regulators *not* exercise discretion when violations occur because the expected penalty from a citizen suit is greater than the penalty that the regulator imposes – a crucial oversight in the analysis of Naysnerski and Tientenberg (1992).

only when these actions are less costly relative to a regulator's enforcement actions. Moreover, if a firm's expected fine from losing a citizen suit is greater than the fine from losing a regulator's enforcement action, the citizen suit can have the positive spill-over effect of reducing the firm's noncompliance levels, as Naysnerski and Tientenberg (1992) propose. However, Langpap (2007) shows that a citizen suit can be counterproductive and result in a worse environmental outcome if the regulator can provide the polluting firm with incentives to comply with environmental laws more efficiently than the CG.

# 3 Model of a Regulatory Enforcement Game

The regulator is modeled as a benevolent government agency tasked with minimizing industry noncompliance with environmental laws. I assume a pre-set industry pollution target and that the regulator takes the target as given when choosing its regulatory enforcement strategy.[29] In an ideal world, the regulator with a limitless budget will choose a regulatory enforcement strategy that induces full compliance with environmental laws. In the real world, the regulator's budget, denoted $B$, is exogenous and limited. The regulator's task is to choose the most efficient combination of regulatory activities – the regulatory strategy – given a fixed budget and the anticipated reaction of the industry in order to minimize the industry's level of noncompliance, $x$.

The regulatory enforcement strategy, or regulatory strategy for short, consists of monitoring activities and enforcement activities. $M$ is the exogenous cost of monitoring the industry and $\alpha$, hereafter referred to as monitoring activity, is the probability that the industry is monitored, or equivalently, the proportion of the industry that the regulator monitors. Expected monitoring expenditures are therefore equal to $\alpha M$. The regulator's enforcement activities are contingent upon discovering industry noncompliance.[30] These activities consist of preparing evidence against the proportion of the industry monitored and the administrative and legal proceedings that are necessary to seek punishment of industry noncompliance in the form of fines, penalties as well as court-ordered sanctions. $E$ is the endogenous amount of enforcement expenditures undertaken against the industry, also referred to as enforcement activity. Expected enforcement expenditures are therefore equal to $\alpha E$.

As in Garvie and Keeler (1994) the judiciary is treated as a non-strategic participant or black-box technology in the regulatory enforcement game. The judiciary is unable to observe the behaviour of the regulated industry. To overcome this asymmetry of infor-

[29] Furthermore, this is not a political economy model in the tradition of public choice theory. For example, there is no regulatory capture. Regulatory capture is when the regulator acts in the interest of the regulated industry instead of the public interest. This could involve the regulator choosing to ignore industrial violations of environmental laws despite having the ability to fine or prosecute the offenders because the industry is an important source of economic growth and wealth creation which could be undermined by enforcement action.

[30] I assume that monitoring activities perfectly detect noncompliance.

mation, the regulator provides the judiciary with information about the industry's polluting behaviour in order for a judicious punishment to be decided. The judiciary authorizes fines, penalties and sanctions against the noncompliant industry, $F(x, E)$. No fines are levied in the absence of noncompliance or enforcement activity, $F(0, E) = F(x, 0) = F(0, 0) = 0$; the fine is increasing in noncompliance at an increasing rate, $F_x > 0$ and $F_{xx} > 0$; the fine is increasing in enforcement activity but at a decreasing rate, $F_E > 0$ and $F_{EE} < 0$; the marginal fine is increasing in enforcement effort, $F_{xE} > 0$.

Also as in Garvie and Keeler (1994), I define $\xi = \frac{EF_{xE}}{F_x}$ as the power of enforcement expenditures to alter the industry's incentives to comply with environmental laws.[31] Also interpreted as the returns to scale from enforcement activity, $\xi$ captures the socio-legal institutional setting in which the regulator chooses its equilibrium regulatory strategy. Socio-legal institutional considerations include judicial willingness to impose large fines, support for the regulator's statutory interpretations, the degree of discretion that the regulator wields, and the strength of socio-political support for enforcement activities. Higher values of $\xi$ reflect a greater capacity of enforcement activity to alter the industry's incentives through higher fines, penalties and court-ordered sanctions.[32] Throughout the model, $\xi$ is assumed to be constant.

The CG is a non-strategic player in the regulatory enforcement game.[33] The CG acts to safeguard citizens from regulatory strategies that permit excessively high levels of industry noncompliance. The CG observes industry noncompliance by consulting the regulator's monitoring records. The CG exerts pressure on the regulator to change its regulatory strategy – to take tougher action against industry noncompliance . This pressure culminates in the CG launching a citizen suit against the regulatory agency.[34]

In a citizen suit involving the CG and the regulator, the industry is publically identified as a polluter violating environmental laws. This public knowledge imposes a cost on the noncompliant industry in the form of reputation costs, $D(x)$. There are no

[31] Technically, $\xi$ is the elasticity of the marginal fine for noncompliance with respect to enforcement expenditures (Garvie and Keeler, 1994).

[32] $\xi$ is bounded from below and above such that $0 < \xi < 1$.

[33] For the purposes of this model I assume that there is a single citizen's group, but it is also possible to model multiple citizen groups.

[34] Note that I assume that the noncompliant industry is not named as a defendant.

reputation costs in the absence of noncompliance, $D(0) = 0$; reputation costs are increasing in noncompliance at an increasing rate, $D_x > 0$, $D_{xx} > 0$. However, these costs are incurred only if there are reputation effects from noncompliance. I assume that reputation costs are not incurred despite a citizen suit, if, for example, the CG cannot attract media interest, the court orders a publication ban, or other similar scenarios arise that prevent the matter from being brought to the public's attention. Moreover, reputation costs are contingent on a citizen suit. There is no mechanism other than a citizen suit against the regulator through which the industry can incur reputation costs. The reputation effect indicator $\delta$ establishes whether these reputation costs are incurred: $\delta = 0$ if false, $\delta = 1$ if true.

The industry consists of a multitude of homogenous firms and is modeled as a representative firm.[35] The industry chooses the level of noncompliance, $x$, that minimize total costs. When choosing its level of noncompliance the industry faces two sets of costs: costs of emissions and expected costs of not complying with environmental laws. Emission costs, denoted $C(x)$, are fully known to the industry and include the costs of installing, maintaining and operating pollution abatement technologies. Industry cost savings from noncompliance are increasing in noncompliance at a decreasing rate $C_x < 0$, $C_{xx} > 0$.[36] Costs of noncompliance include fines, penalities and court-ordered sanctions, $F(x, E)$, and reputation costs from bad publicity arising from a citizen suit, $D(x)$. Expected noncompliance costs are equal to $\alpha[F(x, E) + \delta D(x)]$ and the industry rationally chooses to comply with environmental laws up to the point where the marginal cost of doing so equals the expected marginal cost of not complying.

I assume that citizen suits impose a fixed cost of $V$ on the regulator. The regulator incurs these litigation costs when it prepares its case and defends its regulatory strategy before a court of law. A simplifying assumption in this model is that if citizen suits are permitted, they occur with certainty, contingent upon the industry being monitored, regardless of the industry's level of noncompliance.[37] The sum of expected monitoring expenditures,

[35]The analysis of this model is consistent with the perfectly competitive model of $n$ homogenous firms as in Garvie and Keeler (1994) but I abstract from the quantity of firms in the model to make the analysis more tractable – the results are unaffected.

[36]To abate the first unit of pollution is cheaper than to abatement the second unit which is cheaper to abate than the third unit, and so on. It is convention in the literature to write marginal abatement costs as $-C_x > 0$ and $-C_{xx} < 0$ so that the convex curve can be graphed in the first quadrant.

[37]In other words, if I define $\overline{X}$ to be the threshold level of industry noncompliance for the CG to initiate a

expected enforcement expenditures and expected citizen suit litigation costs cannot exceed the regulator's budget constraint which is exogenously determined by elected legislators and public officials, $\alpha[M + E + V] \leq B$.

The structure underlying the model is adapted from Garvie and Keeler (1994). In the model, three players interact in a single-period Stackelberg game framework.[38] The timing of the regulatory enforcement game is as follows: the regulator announces its regulatory strategy consisting of monitoring and enforcement activities, $\{\alpha, E\}$; the industry chooses a level of noncompliance, $x$; the regulator monitors the industry with probability $\alpha$; the regulator undertakes enforcement activities, $E$ against the portion of the industry monitored; a fine, $F(x, E)$ is levied against the monitored portion of the industry; if permitted, the CG consults the regulator's monitoring activity records and initiates a citizen suit if industry noncompliance exceeds an acceptable level; the citizen suit imposes citizen suit litigation costs, $V$, on the regulator; if there are reputation effects, the citizen suit imposes reputation costs, $D(x)$, on the monitored portion of the industry.

The model section is organized as follows. In subsection 3.1 the industry and regulator decision-problems are presented for the general model. The model is presented in section 3.2.1 with no citizen suits and no reputation effects. In section 3.2.2 the model with citizen suits but no reputation effects is presented. Finally, the impact of citizen suits and the impact of reputation effects are examined separately in sections 3.3 and 3.4, respectively.

## 3.1 General Model

**Industry**

The industry's decision problem is to choose a level of noncompliance $x$ to minimize expected total costs

$$min_{\{x\}} \;\; C(x) + \alpha[F(x, E) + \delta D(x)] \tag{1}$$

citizen suit, the regulator is assumed to have a sufficiently low budget such that monitoring and enforcement activities provide compliance incentives for the industry to undertake a level of noncompliance equal to or greater than $\overline{X}$.

[38] Though the single-period game captures the salient features of the model, it abstracts from issues that a dynamic game could include. For example, the legal proceedings of the citizen suit , the outcome of the suit, and the impact of the citizen suit on the regulatory enforcement strategy in later periods.

Recall that $\delta$ is the citizen suit reputation effects indicator function where $\delta = 0$ is no reputation effects and $\delta = 1$ is reputation effects.

The industry chooses its level of noncompliance according to the following rule:

$$x(\alpha, E; \delta) : C_x(x) + \alpha[F_x(x, E) + \delta D_x(x)] = 0 \tag{2}$$

The industry chooses its level of noncompliance such that the marginal cost of compliance, -$C_x$, equals the expected marginal cost of noncompliance with the environmental laws, $\alpha[F_x + \delta D_x]$. The latter term is the sum of the expected marginal regulatory fine and the expected marginal reputation costs from a citizen suit.

The following relationships follow from equation (2):[39]

$$x_\alpha = -\frac{[F_x + \delta D_x]}{SOC} < 0 \tag{3}$$

$$x_E = -\frac{[\alpha F_{xE}]}{SOC} < 0 \tag{4}$$

$$x_\delta = -\frac{[\alpha D_x]}{SOC} < 0 \tag{5}$$

These partial derivatives reflect the relative deterrence incentives provided by public and private enforcement actions. Increases in any one of regulatory monitoring or enforcement activity or private citizen suit reputation effects decrease the level of industry noncompliance. The latter effect shows that the industry's reputation is a valuable intangible asset. If the industry anticipates that its bottom-line will be negatively impacted by having a reputation of polluting excessively, the industry will undertake additional abatement efforts to diminish its level of noncompliance.

**Regulator**

[39]To express equations (3), (4), and (5), first write $f(x, \alpha, E, \delta) = C_x(x) + \alpha[F_x(x, E) + \delta D_x(x)] = 0$. By the implicit function theorem $x_\alpha = -\frac{f_\alpha}{f_x}$, $x_E = -\frac{f_E}{f_x}$, and $x_\delta = -\frac{f_\delta}{f_x}$, where $f_x = \text{SOC} = C_{xx} + \alpha[F_{xx} + \delta D_{xx}]$. It is assumed that SOC $> 0$ in order to assure the existence a global minimum.

The regulator's decision problem for the general model is to choose a monitoring, $\alpha$, and enforcement, $E$, activities to minimize noncompliance with environmental laws $\{\widetilde{\alpha}, \widetilde{E}\}$

$$min_{\{\alpha,E\}} \quad x \tag{6}$$

subject to the constraints

$$x = x(\alpha, E; \delta) \tag{7}$$

$$\alpha[M + V + E] \leq B \tag{8}$$

Formally, the regulator's design problem consists of choosing a regulatory strategy, $\{\alpha, E\}$, that minimizes the Lagrangian

$$Ł(\alpha, E, \lambda) = x(\alpha, E) + \lambda[\alpha(M + V + E) - B] \tag{9}$$

The first-order conditions can be written as

$$\frac{\partial Ł}{\partial \alpha} = x_\alpha + \lambda(M + V + E) = 0 \tag{10}$$

$$\frac{\partial Ł}{\partial E} = x_E + \alpha\lambda = 0 \tag{11}$$

$$\frac{\partial Ł}{\partial \lambda} = \alpha(M + V + E) - B = 0 \tag{12}$$

The budget constraint is assumed to be binding. The complementary slackness condition for the budget constraint is therefore satisfied, $\lambda[\alpha(M + V + E) - B] = 0$ and $\lambda > 0$. Thus, the point of tangency between the budget constraint and the lowest attainable iso-noncompliance curve determines the equilibrium regulatory strategy. Combining equations (10) and (11) gives the relationship:

$$\frac{x_\alpha}{x_E} = \frac{M + V + E}{\alpha} \tag{13}$$

The right-hand side of equation (13) is the absolute value of the slope of the budget constraint curve, which defines the feasible combinations of monitoring and enforcement activity, $\alpha$ and $E$ that satisfy the budget constraint. The left-hand side is the absolute value of the slope of the industry iso-noncompliance curve, which defines all possible combinations of $\alpha$ and $E$ that induce industry to choose the same level of noncompliance, $\overline{x} = x(\alpha, E; \delta)$. The slope of the iso-noncompliance curve is the marginal rate of substitution between monitoring and enforcement activity.

Substituting equations (3) and (4) into (13) yields

$$\frac{F_x + \delta D_x}{\alpha F_{xE}} = \frac{M + V + E}{\alpha} \tag{14}$$

Multiplying equation (14) on both sides by $\frac{E}{F_x}$, substituting $K = \frac{F_x + \delta D_x}{F_x}$, and rearranging yields

$$\xi = \frac{EK}{M + V + E} \tag{15}$$

Using equation (15) I can find the general form of the equilibrium enforcement strategy by solving for $\widetilde{E}$ and then substituting this expression into equation (12) to find $\widetilde{\alpha}$:

$$\alpha(V, \delta) = \left(\frac{K - \xi}{K}\right)\left(\frac{B}{M + V}\right) \tag{16}$$

$$E(V, \delta) = \frac{\xi}{K - \xi}(M + V) \tag{17}$$

Figure 1, modified from Garvie and Keeler (1994), neatly captures the equilibrium regulatory strategy in the general model. The regulator chooses its equilibrium regulatory strategy $\{\widetilde{\alpha}, \widetilde{E}\}$ such that the budget constraint curve is tangent to the lowest industry attainable noncompliance curve.[40] The slope of these two curves at the equilibrium regulatory strategy is equal to $-\xi\frac{\widetilde{\alpha}}{K\widetilde{E}}$.[41] Both the budget constraint curve and the industry

[40]Note that noncompliance curves further away from the origin represent increasing levels of industry compliance. Thus, for example, in Figure 1, $X_2$ is a lower level of industry noncompliance than $X_0$.

[41]This is found first by substituting $\xi = \frac{EF_{xE}}{F_x}$ into equation (14) where $V > 0$ and $\delta = 1$ and then

iso-noncompliance curve are convex to the origin and the curvature of the latter is assumed to be greater than the former.

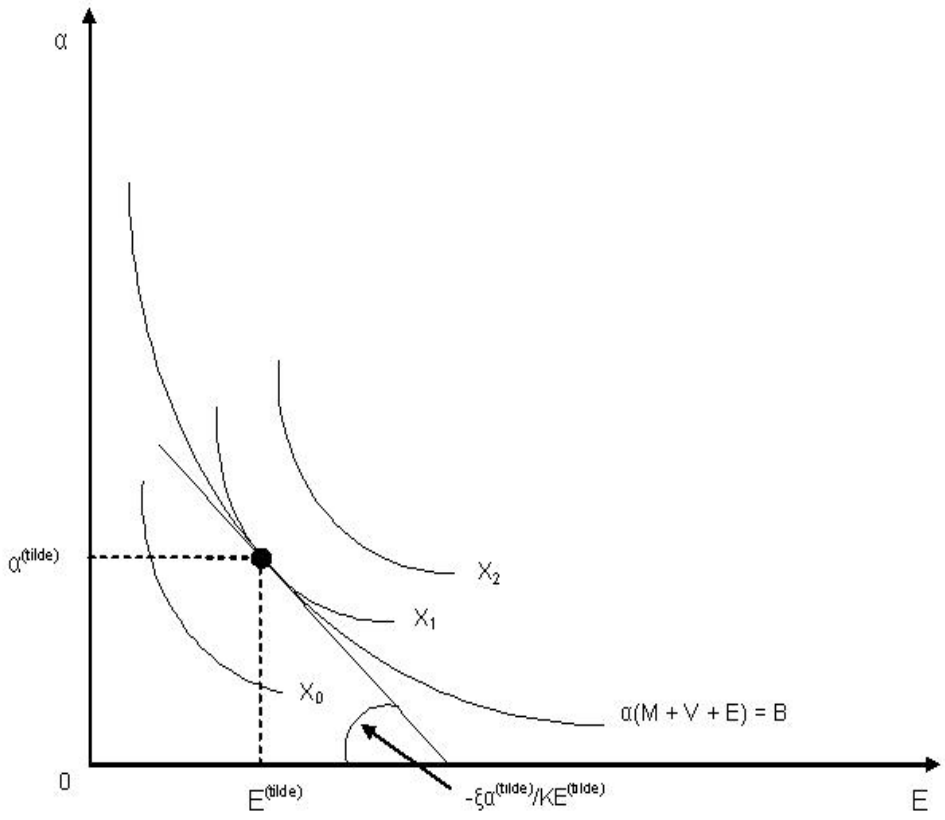


Figure 1: Equilibrium Regulatory Strategy in the General Model

Increases in monitoring costs, $M$, citizen suit litigation expenses, or higher returns to scale of enforcement expenditures, $\xi$, ceteris paribus, induce the regulator to shift to a more deterrence-oriented regulatory regime with higher enforcement expenditures and lower monitoring activity. In other words, the regulator substitutes away from monitoring activity when it becomes more expensive relative to enforcement activity, and the regulator substitutes towards enforcement activity when the regulator's power to alter industry non-compliance incentives using the courts increases. The regulator adopts a more compliance-oriented regulatory strategy as its budget, $B$, increases. All of the new budget dollars are

substituting this result for $\xi$ into the expression $\frac{d\alpha}{dE} = -\frac{\tilde{\alpha}}{M+V+\tilde{E}}$ found by taking the total derivative of equation (12) where $V = 0$.

spent on monitoring activity while enforcement expenditure remain unchanged. Increases in the variable $K$, interpreted as the ratio of total cost of marginal noncompliance to the marginal fine function, induce the regulator to adopt a more compliance-oriented regulatory regime. As marginal reputation costs increase the regulator substitutes monitoring activity for enforcement activity because of the incentive effect of bad publicity from citizen suits on the industry.[42]

**Budget share allocation rule**

Define the budget share allocation rule for monitoring activity as $s_\alpha = \frac{\alpha M}{B}$ and that for enforcement activity as $s_E = \frac{\alpha E}{B}$. The general forms of the budget share allocation rules are found by substituting equations (16) and (17) into the definitions:

$$\widetilde{s_\alpha} = \left(\frac{K-\xi}{K}\right)\left(\frac{M}{M+V}\right) \tag{18}$$

$$\widetilde{s_E} = \frac{\xi}{K} \tag{19}$$

The share of the regulator's budget allocated to enforcement expenditures is increasing in the returns to scale of enforcement expenditures, $\xi$, while the share allocated to monitoring activity is decreasing. Increases in monitoring costs, $M$, or citizen suit litigation expenses, $V$, cut into the share of the regulator's budget allocated to monitoring activity, leaving the share allocated to enforcement expenditures unchanged. In the former case, the share of the regulator's budget allocated to monitoring activity rises consistent with a shift to a more compliance-oriented regulatory regime, while in the latter the share falls consistent with a shift to a more deterrence-oriented regulatory regime.

## 3.2 Special Cases of the General Model

I look at two special cases of the general model: in the following sections the equilibrium regulatory strategy and the budget share allocation rules for each of these

[42] In the case in which there are reputation effects.

cases.

### 3.2.1 GK Case

The first case corresponds to the model of Garvie and Keeler (1994) and is hereafter referred to as the GK case. In this case there are neither citizen suits nor reputation effects ($V = \delta = 0$).

*Proposition 1* : The equilibrium regulatory strategy in the GK case $\{\alpha^*, E^*\}$ is characterized as the following (corresponds to Proposition 1 in Garvie and Keeler (1994)):

$$\alpha^* = (1 - \xi)\frac{B}{M} \tag{20}$$

$$E^* = \frac{\xi}{1 - \xi}M \tag{21}$$

In the absence of citizen suits effective monitoring costs are equal to monitoring costs, $M$. The industry does not incur reputation costs, $D(x)$, and therefore $K = 1$. The parameters $\xi$ and $B$ have the same type of impact on the regulatory strategy as in the general model.

*Proposition 2* : The share of the budget allocated to monitoring activity and enforcement activity are $s^*_\alpha = (1 - \xi)$ and $s^*_E = \xi$, respectively.[43]

The shares of the regulator's budget allocated to monitoring and enforcement activities are simple functions of $\xi$. Increases in the regulator's power to alter the industry's noncompliance incentives increase the share of the regulator's budget allocated to enforcement expenditures and decrease the share of the regulator's budget allocated to monitoring activity.

[43] To show Proposition 2, substitute equations (20) and (21) into the budget share definitions.

### 3.2.2 Citizen Suit Case without Reputation Effects

The second case is referred to as the citizen suit case without reputation effects ($V > 0$, $\delta = 0$). The parameters $\xi$, $B$, $M$, and $V$ have the same type of impact on the equilibirum regulatory strategy and the regulatory budget allocation rules as in the general model. The only difference is that in the absence of reputation effects, $K = 1$.

*Proposition 3*: The equilibrium regulatory strategy in the citizen suit case without reputation effects $\{\widehat{\alpha}, \widehat{E}\}$ is characterized as

$$\widehat{\alpha} = (1 - \xi)\frac{B}{M + V} \tag{22}$$

$$\widehat{E} = \frac{\xi}{1 - \xi}(M + V) \tag{23}$$

Figure 2 graphically captures the equilibrium regulatory strategy in the citizen suit case without reputation effects. In comparison to the GK case, the presence of citizen suit litigation costs flatten the slope of the regulator's budget constraint and shifts it towards the origin. The slope of the tangency condition between the two curves at the equilibrium regulatory strategy will therefore be flatter than in the GK case, $-\xi\frac{\widehat{\alpha}}{\widehat{E}} > -\xi\frac{\alpha^*}{E^*}$. The impact of citizen suits in the absence of reputation is explored in the following section.

*Proposition 4*: The share of the budget allocated to monitoring activity and enforcement activity are $\widehat{s_\alpha} = (1 - \xi)\frac{M}{M+V}$ and $\widehat{s_E} = \xi$, respectively.

The share of the regulator's budget allocated to monitoring is strictly decreasing in $\xi$ while the share allocated to enforcement activity is strictly increasing in $\xi$. The former is also a function of the ratio of monitoring costs to effective monitoring costs. As effective monitoring costs increase the share of the regulator's budget allocated to monitoring activity

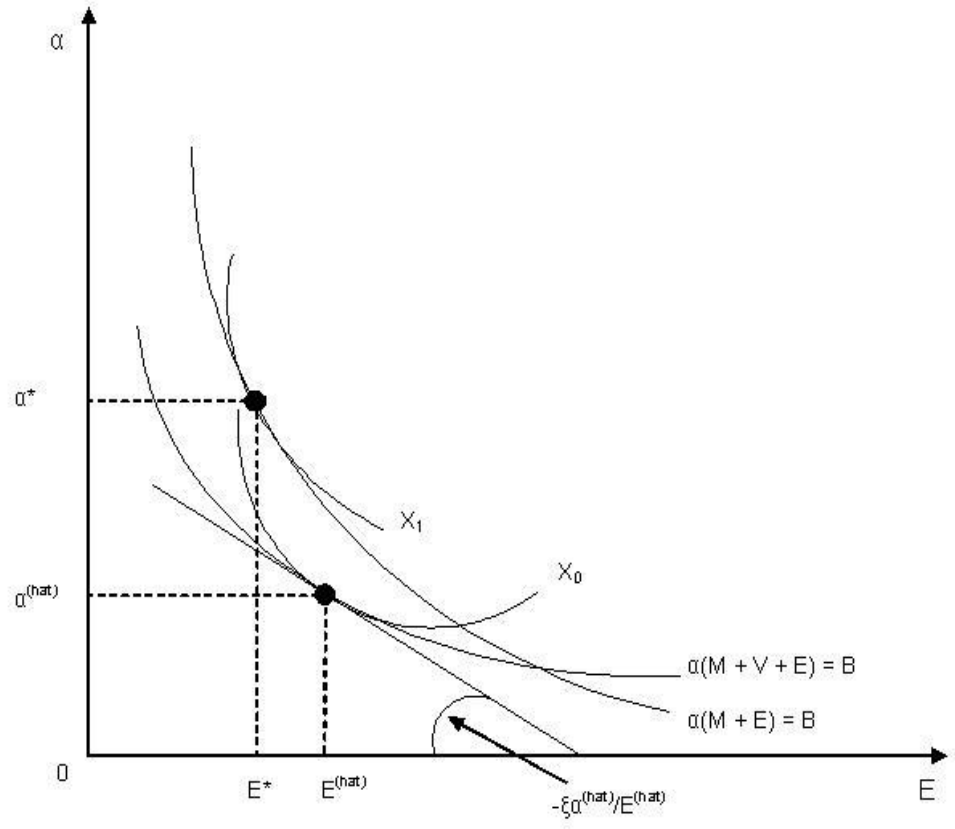


Figure 2: Equilibrium Regulatory Strategy in the Citizen Suit Case without Reputation Effects

falls.[44]

### 3.3 Impact of Citizen Suits in the absence of Reputation Effects

To assess the impact of citizen suits in the absence of reputation effects, I compare the two special cases of the general model. The presence of citizen suit litigation costs, $V$, increases the regulator's effective monitoring costs from $M$ to $\overline{M} = M + V$. The latter is interpreted as the effective monitoring costs, of the regulator in the presence of citizen suit litigation costs such that $M + V = \overline{M}$. Citizen suits increase the regulator's cost of effective monitoring because of the burden that CGs and citizen suit litigation costs place on the regulator. The regulator is the CG's sole source of information on the behaviour

[44]Note that the share of the budget allocated to expected citizen suit expenditures is $\widehat{s_V} = \frac{\hat{\alpha}V}{B} = (1 - \xi)\frac{V}{M+V}$. This share is decreasing in $\xi$, decreasing in monitoring cost, $M$, and increasing in citizen suit costs, $V$.

of the polluting industry and is legally bound to cooperate with the CG on information requests. The regulator must ensure that its industry monitoring records are accessible and reasonably comprehensible to the CG. This commitment to transparency increases the regulator's cost of monitoring the industry. In addition to this burden, the regulator incurs litigation costs from defending its regulatory strategy in a court of law. During the course of a citizen suit the regulator must present evidence on its monitoring and enforcement activities of the regulated industry.

Higher effective monitoring costs induce the regulator to decrease the relatively more expensive monitoring activity and increase the relatively less expensive enforcement activity. Thus, citizen suits in the absence of reputation effects induce the regulator to adopt a more deterrence-oriented enforcement strategy. The sign of the change in monitoring activity and enforcement activity is shown as follows:

$$\begin{aligned} \Delta\alpha &= \widehat{\alpha} - \alpha^* && (24)\\ &= (1-\xi)\frac{B}{M+V} - (1-\xi)\frac{B}{M} && (25)\\ &= -\frac{(1-\xi)BV}{M(M+V)} < 0 && (26) \end{aligned}$$

$$\begin{aligned} \Delta E &= \widehat{E} - E^* && (27)\\ &= \frac{\xi}{1-\xi}(M+V) - \frac{\xi}{1-\xi}M && (28)\\ &= \frac{\xi}{1-\xi}V > 0 && (29) \end{aligned}$$

The regulator is unambiguously worse-off in the presence of citizen suits without reputation effects. The adoption of a more deterrence-oriented enforcement strategy as a result of higher effective monitoring costs leads to a higher level of industry noncompliance with environmental laws. This impact on the industry's level of noncompliance is shown as

follows:

$$\begin{aligned}
\Delta x &= x_\alpha \Delta\alpha + x_E \Delta E && (30)\\
&= x_\alpha \left[ -\frac{(1-\xi)BV}{M(M+V)} \right] + x_E \frac{\xi}{1-\xi} V && (31)\\
&= V \left[ -\frac{(1-\xi)}{M(M+V)} B \left( -\frac{F_x}{SOC} \right) + \frac{\xi}{1-\xi} \left[ -\frac{\widehat{\alpha} F_{xE}}{SOC} \right] \right. && (32)\\
&= \frac{\widehat{\alpha} V}{SOC} \left[ \frac{F_x}{M} - \frac{\xi}{1-\xi} F_{xE} \right] && (33)\\
&= \frac{\widehat{\alpha} V}{SOC} \left[ \frac{F_x}{M} - \frac{\widehat{E} F_{xE}}{M+V} \frac{F_x}{F_x} \right] && (34)\\
&= \frac{(1-\xi) M V F_x}{SOC(M+V)} \left[ \frac{1}{M} - \frac{\xi}{M+V} \right] && (35)\\
&= \frac{(1-\xi) V F_x}{SOC(M+V)^2} \left[ M(1-\xi) + V \right] > 0 && (36)
\end{aligned}$$

The corollary from this result is that the industry is strictly better-off. Citizen suit litigation costs cut into the regulator's budget reducing the proportion of the budget allocated to monitoring and enforcement activities. The overall effect of the regulator's shift to a more deterrence-oriented regulatory regime is to induce the industry to increase its level of noncompliance.

Despite the good intentions of the CGs in bringing forth citizen suits against the regulator, the citizen suits ultimately only serve to hamper the effective operations of the regulator. In the absence of reputation effects, citizen suits only impose costs on the regulator. Citizen suits do not provide deterrence incentives to industry and thereby do not provide any benefits at the margin to the regulator.[45]

Comparing Proposition 4 to Proposition 2, it is clear that forced to incur citizen suit litigation costs, the regulator chooses to reduce the share of its budget allocated to monitoring activity and leaves the share allocated to enforcement expenditures unchanged, shown as follows:

[45]The absence of reputation effects is consistent with the lack of news media interest in providing coverage and analysis of the court case, or the existence of a court-ordered publication ban that effectively limits the public's knowledge of the noncompliant behaviour of the industry – the citizen suit does not generate negative publicity about the industry's noncompliant behaviour.

$$\Delta s_\alpha = \widehat{s_\alpha} - s_\alpha^* \tag{37}$$
$$= (1-\xi)\frac{M}{M+V} - (1-\xi) \tag{38}$$
$$= -\frac{(1-\xi)V}{M+V} < 0 \tag{39}$$

$$\Delta s_E = \widehat{s_E} - s_E^* \tag{40}$$
$$= \xi - \xi \tag{41}$$
$$= 0 \tag{42}$$

In this budgetary reallocation, the decrease in the regulator's monitoring activity is exactly offset by the increase in the regulator's citizen suit expenditures. The change in the share of the regulator's budget allocated to monitoring activity is equal to the share of the regulator's budget now allocated to citizen suit litigation costs.

### 3.3.1 Impact of changes in the parameters $B$, $M$, $V$, and $\xi$

When comparing the citizen suit case without reputation effects to the GK case changes in the parameters $B$, $M$, $V$, and $\xi$ impact the magnitude of the differences in monitoring activity, enforcement activity, and the share of the regulator's budget allocated to monitoring activity. How each parameter impacts these magnitudes is as follows:

Impact of $B$:

$$\frac{\partial \Delta\alpha}{\partial B} = -\frac{(1-\xi)V}{M(M+V)} < 0 \tag{43}$$
$$\frac{\partial \Delta E}{\partial B} = 0 \tag{44}$$
$$\frac{\partial \Delta s_\alpha}{\partial B} = 0 \tag{45}$$

Increasing the regulator's budget decreases the magnitude of the difference in mon-

itoring activity when comparing these two cases. This means that the greater the increase in the regulator's budget the smaller will be the fall in monitoring activity in the citizen suit case with reputation effects compared to that of the GK case. The magnitude of the difference in enforcement activity and the share of the regulator's budget allocated to monitoring is independent of changes to the regulator's budget.

Impact of $M$:

$$\frac{\partial \Delta\alpha}{\partial M} = \frac{(1-\xi)BV[2M+V]}{[M(M+V)]^2} > 0 \tag{46}$$

$$\frac{\partial \Delta E}{\partial M} = 0 \tag{47}$$

$$\frac{\partial \Delta s_\alpha}{\partial M} = \frac{(1-\xi)V}{(M+V)^2} > 0 \tag{48}$$

Higher costs of monitoring the industry increase the magnitude of the difference in the regulator's monitoring activity and the share of the regulator's budget allocated to monitoring activity when comparing these two cases. The magnitude of the difference in enforcement activity is independent of changes in the cost of monitoring the industry.

Impact of $V$:

$$\frac{\partial \Delta\alpha}{\partial V} = -\frac{(1-\xi)B}{[(M+V)]^2} < 0 \tag{49}$$

$$\frac{\partial \Delta E}{\partial V} = \frac{\xi}{1-\xi} > 0 \tag{50}$$

$$\frac{\partial \Delta s_\alpha}{\partial V} = -\frac{(1-\xi)M}{(M+V)^2} < 0 \tag{51}$$

The greater the citizen suit litigation costs the regulator incurs, the smaller the magnitude of the difference in monitoring activity and the share of the regulator's budget allocated to monitoring activity in the citizen suit case without reputation effects compared to the GK case. At the same time, higher citizen suit litigation costs increase the magnitude of the difference in enforcement activity between the two cases.

Impact of $\xi$:

$$\frac{\partial \Delta\alpha}{\partial \xi} = \frac{BV}{M(M+V)} > 0 \tag{52}$$

$$\frac{\partial \Delta E}{\partial \xi} = \frac{V}{(1-\xi)^2} > 0 \tag{53}$$

$$\frac{\partial \Delta s_\alpha}{\partial \xi} = \frac{V}{M+V} > 0 \tag{54}$$

The greater the power of enforcement expenditures to alter the industry's incentives to comply with environmental laws, the greater the magnitude of the difference in monitoring activity, the share of the regulator's budget allocated to monitoring activity, and enforcement activity in the citizen suit case without reputation effects compared to the GK case.

The parameter $\xi$, but not $B$, affects the magnitude of the change in the level of industry noncompliance.[46] The impact of changes in $\xi$ on the magnitude of the change in the level of noncompliance is as follows:

$$\frac{\partial \Delta x}{\partial \xi} = -\frac{MVF_x}{SOC(M+V)}\left(\frac{1}{M} - \frac{\xi}{M+V}\right) - \left(\frac{1}{M+V}\right)\left(\frac{(1-\xi)MVF_x}{SOC(M+V)}\right) \tag{55}$$

$$< 0 \tag{56}$$

Increases in the power of enforcement expenditures to alter firm incentives to comply with environmental laws diminishes the magnitude of the increase in the level of industry noncompliance. Thus despite the fact that citizen suits increase industry noncompliance, higher levels of $\xi$ can help to reduce the severity of this increase in noncompliance. Higher values of $\xi$ reflect, for example, more jurisprudence in the field of environmental law with decisions in favour of the plaintiffs in citizen suits – favourable precedents facilitate future citizen suits as case law develops.

[46] Note that though it is also affected by the parameters $M$, and $V$, due to the presence of the terms $SOC$ and $F_x$, both of which are functions of both these parameters, the impact of changes in these parameters upon the level of noncompliance is much more difficult to sort out.

### 3.4 Impact of Reputation Effects given Citizen Suits

To assess the impact of reputation effects, I compare the citizen suit case with reputation effects (the general model) to the citizen suit case without reputation effects. Given citizen suits, the presence of reputation effects induces the regulator to adopt a more compliance-oriented enforcement strategy. Although the effective monitoring cost is the same in both cases, higher levels of monitoring activity increase the expected reputation costs that the non-compliant industry suffers from citizen suits. The regulator therefore has the incentive to substitute away from enforcement and towards monitoring acitivty. The sign of the change in monitoring and enforcement activity is shown as follows:

$$\begin{aligned}
\Delta\alpha &= \widetilde{\alpha} - \widehat{\alpha} && (57)\\
&= \left(\frac{K-\xi}{K}\right)\left(\frac{B}{M+V}\right) - (1-\xi)\frac{B}{M+V} && (58)\\
&= \frac{B}{M+V}\left[\frac{K-\xi}{K} - (1-\xi)\right] && (59)\\
&= \frac{B\xi(K-1)}{K(M+V)} > 0 && (60)
\end{aligned}$$

$$\begin{aligned}
\Delta E &= \widetilde{E} - \widehat{E} && (61)\\
&= \frac{\xi}{K-\xi}(M+V) - \frac{\xi}{1-\xi}(M+V) && (62)\\
&= \xi(M+V)\left[\frac{1}{K-\xi} - \frac{1}{1-\xi}\right] && (63)\\
&= -\frac{\xi(M+V)(K-1)}{(K-\xi)(1-\xi)} < 0 && (64)
\end{aligned}$$

Graphically, the addition of reputation costs to the citizen suit case affects the industry noncompliance curve while the budget constraint is unchanged. The slope of the iso-noncompliance curve decreases. As a result, the tangency condition in the citizen suit case with reputation costs occurs at a slope of -$\xi\frac{\widetilde{\alpha}}{K\widetilde{E}}$ which is steeper than in the citizen

suit case without reputation effects, $-\xi\frac{\widetilde{\alpha}}{K\widetilde{E}} < -\xi\frac{\widehat{\alpha}}{\widehat{E}}$.[47] Consistent with the shift to a more compliance-oriented regulatory regime, the share of the regulator's budget allocated to monitoring activity rises and that of enforcement expenditures falls.

In equilibrium, the regulator adopts a more compliance-oriented regulatory regime when there are citizen suits in the presence of reputation costs to polluters. This shift in regulatory regime coupled with reputation effects changes the industry's noncompliance incentives. Higher levels of monitoring activity increases the amount of information that the regulator collects on industry behaviour. The CG obtains access to this information and enhances its ability to publically expose the polluting behaviour of the industry during the course of the citizen suit. Aware of its vulnerability to such public revelations, the industry chooses *ex ante* to lower its level of noncompliance in order to reduce its liability from reputation costs.

*Proposition 5*: The overall impact on industry noncompliance from citizen suits in the presence of reputation effects is for the level of noncompliance to fall.

*Proof*

First note that the following must be true:

$$\widetilde{\alpha}[F_x(x,\widetilde{E}) + D_x] > \widehat{\alpha}[F_x(x,\widehat{E}) + D_x] \tag{65}$$

Otherwise, the regulator would not alter its regulatory strategy, such that $\widetilde{\alpha} > \widehat{\alpha}$ and $\widetilde{E} < \widehat{E}$.

Figure 3 graphically illustrates the level of noncompliance that the industry chooses such that the marginal cost of compliance, $-C_x$, equals the expected marginal cost of noncompliance under three different scenarios. These three scenarios are described from top to

[47] In the citizen suit case with reputation effects the tangency condition is found by substituting $\xi = \frac{EK}{M+V+E}$ into the expression of $\frac{\partial\alpha}{\partial E}$ derived from the total derivative of equation (12). Recall from equations (14) and (15) that the slope of the iso-noncompliance curve at the equilibrium regulatory strategy is $-\frac{x_\alpha}{x_E} = -\frac{F_x+\delta D_x}{\alpha F_{xE}}$. Thus, $-\frac{\partial\frac{x_\alpha}{x_E}}{\partial\delta} = -\frac{D_x}{\alpha F_{xE}} < 0$.

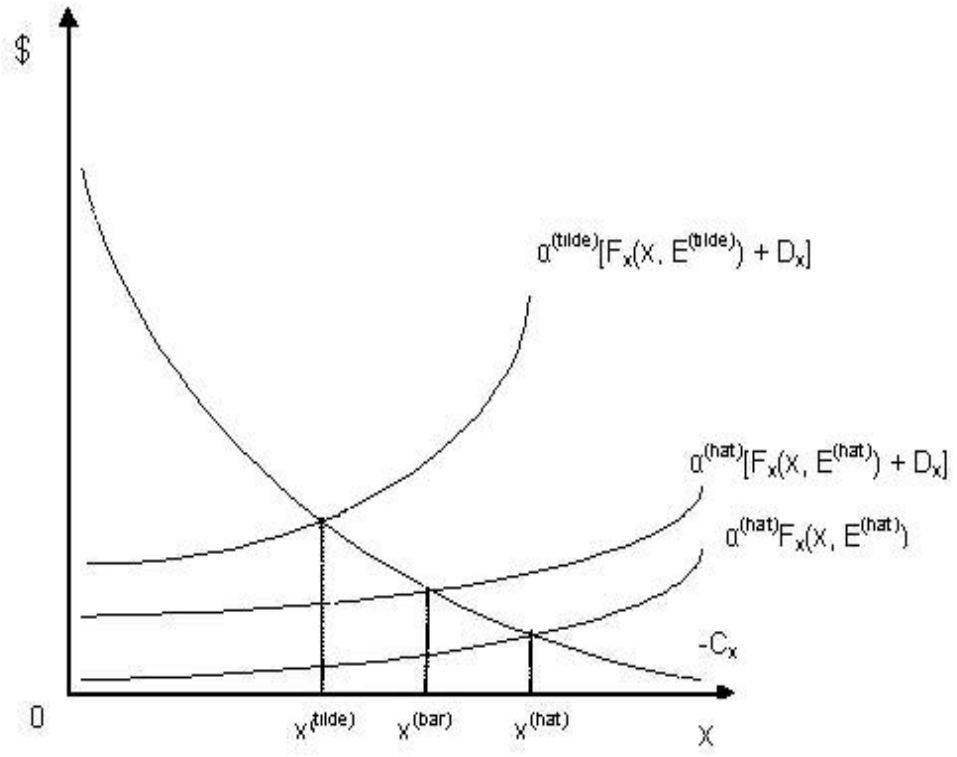


Figure 3: Industry's Equilibrium Noncompliance Choice

bottom as follows. The first and third marginal cost of noncompliance curves are consistent with those of the general model in which there are citizen suits with reputation effects, and the special case in which there are citizen suits without reputation effects, respectively. The second curve is the marginal noncompliance curve when the regulator does not account for reputation effects when choosing a regulatory strategy.[48]

To begin, I assume that the equilibrium regulatory strategy $\{\widehat{\alpha}, \widehat{E}\}$ is chosen under the citizen suit case without reputation effects. Now, suppose $\delta = 1$, resulting in the noncompliant industry suffering reputation costs from citizen suits, but that the regulator persists in choosing the regulatory strategy $\{\widehat{\alpha}, \widehat{E}\}$. Since $D_x > 0$ for all $x > 0$, $\overline{x} < \widehat{x}$.

[48]In Figure 4, the industry's choice of noncompliance with environmental laws is labelled $x$(tilde) for the citizen suit case with reputation effects, $x$(hat) for the citizen suit case without reputation effects, and $x$(bar) for the hypothetical scenario in which reputation costs are accounted for in the marginal cost of compliance curve under the citizen suit case without reputation effects. In the following paragraphs, $x$(tilde) corresponds to $\widetilde{x}$, $x$(hat) corresponds to $\widehat{x}$, and $x$(bar) corresponds to $\overline{x}$.

In other words, in the presence of reputation effects, noncompliance will fall without any change in the regulatory strategy. However, the chosen regulatory strategy must be efficient, and efficiency requires that the regulator increase $\alpha$ from $\widehat{\alpha}$ to $\widetilde{\alpha}$ and decrease $E$ from $\widehat{E}$ to $\widetilde{E}$. The changes in $\alpha$ and $E$ must be such that, as shown in Figure 4, $\widetilde{x} < \overline{x} < \widehat{x}$. If not, then the regulatory strategy $\{\widehat{\alpha}, \widehat{E}\}$ is efficient in the citizen suit case with reputation effects, a contradiction.

After some manipulation equation (65) can be rewritten as $(F_x + D_x)\Delta\alpha + \alpha F_{xE}\Delta E > 0$. Total differentiating the firm's first-order condition, equation (2), yields:

$$[C_{xx} + \alpha(F_{xx} + \delta D_{xx})]dx + [F_x + \delta D_x]d\alpha + \alpha F_{xE}dE + \alpha D_x d\delta = 0 \tag{66}$$

Rearranging equation (66) yields:

$$dx = -\frac{1}{SOC}\left[(F_x + \delta D_x)d\alpha + \alpha F_{xE}dE + \alpha D_x d\delta\right] < 0 \tag{67}$$

Consequently, the level of industry noncompliance falls and the regulator is therefore strictly better-off when there are reputation effects in the presence of citizen suits compared to when reputation effects are absent. In the presence of reputation effects, the citizen suit against the regulator imposes a cost on the regulated industry as its noncompliance with environmental laws is revealed to the public. This public knowledge damages the reputation of the industry. The bad publicity reduces the revenues of the industry as consumers boycott or reduce their consumption of the industry's product(s) and forces the industry to undertake costly public relations campaigns and outreach programs to defend the company's reputation. When an industry's reputation is vulnerable to revelations of noncompliance with environmental laws it will undertake additional abatement efforts to minimize the total costs that it is expected to incur as a result of not complying with environmental laws. Thus, despite the citizen suit costs that the regulator incurs, it welcomes the incentive effects that the citizen suit has on industry behaviour and encourages higher expected reputation costs by increasing its monitoring activity.

Comparing Proposition 4 with equations (18) and (19), the regulator chooses to increase its share of the budget allocated to monitoring activity and decrease its share of

the budget allocated to enforcement activity.

$$\begin{aligned}
\Delta s_\alpha &= \widetilde{s_\alpha} - \widehat{s_\alpha} && (68)\\
&= \left(\frac{K-\xi}{K}\right)\left(\frac{M}{M+V}\right) - \frac{(1-\xi)M}{M+V} && (69)\\
&= \frac{(K-\xi)M - KM(1-\xi)}{K(M+V)} && (70)\\
&= \frac{\xi M(K-1)}{K(M+V)} > 0 && (71)
\end{aligned}$$

$$\begin{aligned}
\Delta s_E &= \widetilde{s_E} - \widehat{s_E} && (72)\\
&= \frac{\xi}{K} - \xi && (73)\\
&= -\frac{\xi(K-1)}{K} < 0 && (74)\\
& && (75)
\end{aligned}$$

### 3.4.1 Impact of changes in the parameters $B$, $M$, $V$, and $\xi$

When comparing the citizen suit case with reputation effects to the citizen suit case without reputation effects changes in the parameters $B$, $M$, $V$, and $\xi$ impact the magnitude of the difference in monitoring activity, enforcement activity, the share of the regulator's budget allocated to monitoring activity, and the share of the regulator's budget allocated to enforcement activity. The sign of how each parameter impacts these magnitudes is as follows:

Impact of $B$:

$$\begin{aligned}
\frac{\partial \Delta\alpha}{\partial B} &= \frac{\xi(K-1)}{K(M+V)} > 0 && (76)\\
\frac{\partial \Delta E}{\partial B} &= 0 && (77)\\
\frac{\partial \Delta s_\alpha}{\partial B} &= 0 && (78)\\
\frac{\partial \Delta s_E}{\partial B} &= 0 && (79)
\end{aligned}$$

Increasing the regulator's budget increases the magnitude of the difference in monitoring activity when comparing these two cases. However, changes in the regulator's budget have no impact on the magnitude of the difference when considering enforcement activity, and when considering the shares of the regulator's budget allocated to both monitoring activity and enforcement activity.

Impact of $M$:

$$\frac{\partial \Delta\alpha}{\partial M} = -\frac{KB\xi(K-1)}{[K(M+V)]^2} < 0 \tag{80}$$

$$\frac{\partial \Delta E}{\partial M} = -\frac{\xi(K-1)}{(K-\xi)(1-\xi)} < 0 \tag{81}$$

$$\frac{\partial \Delta s_\alpha}{\partial M} = \frac{KV\xi(K-1)}{[K(M+V)]^2} > 0 \tag{82}$$

$$\frac{\partial \Delta s_E}{\partial M} = 0 \tag{83}$$

Higher costs of monitoring the industry diminish the magnitude of the difference in monitoring activity and enforcement activity when comparing these two cases. However, while higher cost of monitoring the industry also increase the magnitude of the difference between the share of the regulator's budget allocated to monitoring activity in these two cases, the magnitude of the difference for enforcement activity remains unchanged.

Impact of $V$

$$\frac{\partial \Delta\alpha}{\partial V} = -\frac{KB\xi(K-1)}{[K(M+V)]^2} < 0 \tag{84}$$

$$\frac{\partial \Delta E}{\partial V} = -\frac{\xi(K-1)}{(K-\xi)(1-\xi)} < 0 \tag{85}$$

$$\frac{\partial \Delta s_\alpha}{\partial V} = -\frac{KM\xi(K-1)}{[K(M+V)]^2} < 0 \tag{86}$$

$$\frac{\partial \Delta s_E}{\partial V} = 0 \tag{87}$$

The greater the citizen suit litigation costs that the regulator incurs the smaller the magnitude of the difference in monitoring activity, the share of the regulator's budget

allocated to monitoring activity, and enforcement activity when comparing these two cases. The magnitude of the difference in the share of the regulator's budget allocated to enforcement activity is independent of changes in citizen suit litigations costs.

Impact of $\xi$:

$$\frac{\partial \Delta\alpha}{\partial \xi} = \frac{B(K-1)}{K(M+V)} > 0 \tag{88}$$

$$\frac{\partial \Delta E}{\partial \xi} = -\left(\frac{(K-\xi)(1-\xi)(M+V)(K-1) - \xi(M+V)(K-1)(2\xi-K-1)}{[(K-\xi)(1-\xi)]^2}\right) \tag{89}$$

$$< 0 \tag{90}$$

$$\frac{\partial \Delta s_\alpha}{\partial \xi} = \frac{M(K-1)}{K(M+V)} > 0 \tag{91}$$

$$\frac{\partial \Delta s_E}{\partial \xi} = -\frac{K-1}{K} < 0 \tag{92}$$

The greater the power of enforcement expenditures to alter the industry's incentives to comply with environmental laws, the greater the magnitude of the difference in monitoring activity and the share of the regulator's budget allocated to monitoring activity when comparing these two cases. In contrast, the magnitude of the difference in enforcement activity as well as the share of the regulator's budget allocated to enforcement activity are smaller when the returns to scale of enforcement activity are greater.

# 4 Conclusion

In this essay, I investigated the impact that citizen suits and reputation costs have on the regulator's equilibrium regulatory strategy and the industry's choice of noncompliance with environmental laws. The results show that the regulator is unambiguously worse-off when there are citizen suits and reputation effects are absent. Citizen suit costs cut into the regulator's limited budget reducing the amount allocated to monitoring activities forcing the regulator to adopt a more deterrence-oriented regulatory regime. This has the effect of permitting the industry to increase its level of noncompliance with environmental laws. The regulator is unambiguously better-off, however, when there are reputation effects in the presence of citizen suits. In the citizen suit case with reputation effects the regulator adopts a more compliance-oriented regulatory strategy. This shift in strategy coupled with the reputation costs that the noncompliant industry incurs from citizen suits *ex ante* induces the industry to choose a lower level of noncompliance than it would otherwise do in the absence of reputation effects.[49]

The insights that the results of this essay provide are closely linked to the studies of Naysnerski and Tientenberg (1992), Heyes and Rickman (1999), and Langpap (2007) as discussed in section 2.2. One of the major divergences in the predictions of Naysnerski and Tietenberg (1992) versus Heyes and Rickman (1999) was that of the role of CGs as substitutes for regulatory action. Langpap's (2007) model allows a formal analysis of the conditions under which a CG's citizen suit can promote efficiency gains as a substitute to government enforcement action against a noncompliant industry. Langpap, however, does not consider the environmental outcome. What this essay has shown is that citizen suits lead to a lower level of industry noncompliance when there exist mechanisms whereby citizen suits induce the noncompliant industry to reduce its polluting behaviour. In the model of this essay, this mechanism was modeled as reputation effects. When, in the presence of reputation effects, CGs initiate private enforcement actions against the regulatory authority charged with enforcing environmental laws, the citizen suits force the noncompliant indus-

[49]Note that the extent to which the shift in the regulatory regime and the reputation costs impact industry noncompliance incentives relative to the case in which there is neither citizen suits nor reputation effects was not investigated in this essay due to the complexity of such an undertaking. This undertaking would correspond to comparing the results of the citizen suit case with reputation effects to the GK case.

try to internalize (at least some of) the social costs that its polluting behaviour imposes upon society. Reputation costs, $D(x)$, are, in essence, the uninternalized damage costs, or some partial representation thereof. The internalization of these damage costs provides the polluting industry with the incentive to reduce its level of noncompliance.

The model in this essay exploited a simple binary control variable to capture the presence of reputation effects.[50] A possible interpretation of the absence of reputation effects could be that there is no public education about the polluting behaviour of the noncompliant industry. Explanations for this include the inability of the citizen suit to effectively communicate information about the noncompliant industry's behaviour through media such as the press, radio outlets, news telecasts, internet postings and blogs, public demonstrations and word of mouth. This inability could also be the fault of the CG that fails to engage in a successful public information campaign, the hostility or indifference of news media and the public, or the court-ordered suppression of details about the substantive nature of the allegations and evidence against the polluting industry.

There are important policy implications to be drawn from the results of this essay. The CGs should launch citizen suits against the regulator when there are reputation effects and should be prevented from doing so when there are no reputation effects. For the private enforcement actions of CGs against the regulator to lead to superior environmental outcomes, the citizen suits need to occur in an institutional framework that allows the truth about a polluting industry's noncompliant behaviour to be brought to light. An industry's reputation is a valuable intangible asset. If that asset can be damaged by public disclosure about the industry's noncompliance with environmental laws, the industry will have the incentive to comply with those laws to a greater degree than if there were no costs from public disclosure about its noncompliant behaviour. Part of this supportive institutional framework would be the existence of substantial case law to aid courts in navigating through the complex and otherwise novel arguments that CGs offer during the course of citizen suits. In the model, the existence of such jurisprudence with decisions in favour of the plaintiffs

[50] In reality, however, reputation effects are a continuous variable that are a function of other parameters. Consumer loyalty to brandnames and citizen sympathy for local business interests can dampen the reputation costs of an exposed noncompliant industry. Conversely, consumer and citizen hostility can aggravate the reputation costs that an exposed noncompliant industry can suffer.

in citizen suits would correspond to a greater value of $\xi$, providing greater influence on industry's incentives to comply with environmental law.

Several simplifying assumptions in the model reduced the complexity of the analysis. The costs that citizen suit impose on the regulator is fixed at $V$ as is the parameter that captures the socio-legal institutional setting in which the regulatory enforcement game transpires, $\xi$. Relaxing either of these assumptions would reflect a more realistic theoretical model. For example, the regulator's citizen suit costs could be a function of the level of industry noncompliance so that higher levels of industry noncompliance could impose greater citizen suit costs on the regulator. In a more realistic model the returns to scale from enforcement activity, $\xi$, would not be constant but would instead be a function of the industry's level of noncompliance and the regulator's enforcement expenditures. Furthermore, this model did not attempt to model the decision-making behaviour of CGs when choosing whether or not to launch citizen suits, nor were the court decisions in citizen suits, and the impacts that these would have on the players in the regulatory enforcement game, considered.

The model of this essay suggests subjects for further research. What is the equilibrium impact of citizen suits with reputation effects compared to the no citizen suit case? How do the results of the model change when modeling a dynamic game in which the outcome of the citizen suit against the regulator can have additional repercussions on the equilibrium regulatory strategy in later periods? What would be the spillover consequences on industry noncompliance from the regulator being forced to modify its regulatory strategy in accordance with a court verdict in a citizen suit case? Even if a citizen suit is desirable from the perspective of environmental protection, what are the overall welfare implications from citizen suits? How would the equilibrium results change with multiple CGs deciding whether to launch citizen suits against either the regulator or the polluting industry? These are some of the questions that further research can seek to answer.

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