Relying on the Information of Interested—and Potentially Dishonest—Parties

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This article investigates the role of evidence production in the regulation of private behavior via judicial and administrative process. It proposes a model in which the law makes the agent's "fine" depend on the presentation of evidence whose production cost, in turn, depends on how the agent has behaved in the regulated activity. This view of evidence production has several notable implications, including that truth finding has no direct role in deterrence, that nonfalsifiable evidence, even when available, is unlikely to be the best choice for the system, and that "overdeterrence" may well be cost-effective.

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The incentive-based regulation of private behavior—whether enforced through civil, criminal, or administrative process—requires that "punishments" and "rewards" be appropriately conditioned on how individual agents behave in the regulated activity. In many areas of the law, the state obtains at least some of this information from the agents themselves. Instead of, or in addition to, its own active inspection and investigation, the state invites the party in interest to come forward to prove compliance, desert, or innocence.

Thus, the manufacturer of a new drug must present the FDA with "substantial evidence" that the drug is effective for its intended use, in compliance with 21 U.S.C. 355(d). Similarly, the inventor may provide affidavits, declarations, and other outside evidence in filing her appeal of a rejected patent application, as provided in 37 C.F.R. 1.192-6 (1994). The industrial firm, likewise, must often sample and report to the EPA on emissions content in compliance with the Clean Air Act, 42 U.S.C. 7414(a), and the Clean Water Act, 33 U.S.C. 1318. In civil process, the tort defendant may offer testimony of her reasonable care in order to avoid liability. In criminal process, the accused may try to corroborate an alibi.

But how is it possible for the state to effectively regulate the agent—in particular, to induce her to do something that otherwise is not in her interest—if the state relies, in whole or in part, on the agent's own account of whether she has actually behaved as it desires? Certainly, it cannot be enough that the manufacturer *says* the drug is effective, or that the accused *says* she is innocent. This fundamental, but often ignored, question is the focus of the present article. The proposed answer is a new perspective on evidence production that has advantages, in terms of both coherence and realism, over how evidence production has been treated in the literature to date.

Conceptually, the model goes beyond existing approaches in two respects. First, it captures the full *double* incentive problem, integrating incentives for behavior in both the "primary activity" and the subsequent hearing.[1] Second, it allows for the possibility that agents will lie when it is in their interest to do so. The central idea of this article is to view evidence production as costly signaling, à la Spence (1974), but

1. The primary activity is the activity giving rise to prosecution, suit, or administrative review (e.g., crime, care taking, or pollution control).

to augment that model by supposing that the agent's evidence (signal) production costs are potentially affected by her choice of action in the primary activity.

This view of evidence has a number of counterintuitive implications that make it operationally, as well as conceptually, distinct from existing approaches. First, no amount of truth finding is necessary for achieving deterrence in this model. Deterrence may be possible even though the court or review board learns nothing about what actually happened in the primary activity. Second, despite the conventional assumption that additional accuracy is always more socially expensive, learning more about the primary activity often costs *less*, not more. Third, "overdeterrence" in the primary activity is likely to be optimal. When the system costs of incentive setting are accounted for, it tends to be optimal to require more of individuals than is warranted by the classic balancing of social costs and benefits in the primary activity. This creates the apparent contradiction that the state will typically want to "buy" *more* precaution or clean air, when it accounts for the "price" of these items in terms of enforcement effort.

The research strategy underlying this article is to focus on one component of the regulatory information problem: use of information about an agent's behavior as *supplied by the agent herself.* While this component is important and essential in proceedings as various as administrative review and multiparty litigation, it is rarely the only mechanic at work in the complexity of actual process. Criminal procedure, for example, includes active investigation by the state in the guise of detectives, police, and prosecutors. Both civil and criminal procedures involve intricate adversarial dynamics. In civil procedure, the filing of suit is itself a signal of plaintiff's information. Even ex parte administrative procedures often rely not just on the party's own evidence but also on information independently gathered by the regulator. Thus, the aim here is not to convince the reader that own-party evidence is the only enforcement dynamic worth studying. Rather, the object is to distill and then analyze one element that, although common and fundamental to many settings of interest, is often ignored in the law and economics of litigation and enforcement. Hopefully, once this

element is fully understood in isolation, its interaction with other sources of regulatory information can be more fruitfully examined.[2]

1. Discussion

1.1. Existing Formalisms

Before explaining the model and its implications, it is important to be clear about the conceptual differences between the view of evidence production proposed here and views that already appear in the formal literature on evidence. That literature sorts roughly into three approaches. While each approach represents an important step forward in understanding the logic of enforcement and information, none accounts for the full strategic nature of the problem to which evidence production is the apparent solution.

The first and oldest formal approach to legal evidence, the (pure) *Bayesian* approach, supposes that the fact finder considers evidence the way a physical scientist considers inanimate data: by making deductions that combine prior beliefs with an understanding of how observations tend to be associated with underlying truths—that is, according to Bayes' Rule.[3] Many have criticized the Bayesian approach for its false precision (see, e.g., Tribe, 1970). But perhaps more problematic is its failure to account for the strategic nature of evidentiary presentation. The molecules under the scientist's microscope have no particular interest in what the scientist concludes, nor any ability to influence her conclusion. Neither can be said of the agent who supplies evidence of her own behavior, evidence that she understands will be used to set her own punishments and rewards.

Equally serious is the failure of the Bayesian approach to account for how legal rules influence behavior in the primary activity. Indeed, influencing behavior in the primary activity is arguably the main purpose of

2. Understanding such interaction is the aim of a companion paper (Sanchirico, 2000), which considers both own-party information and information supplied by others, and also examines the signaling role of the act of filing suit.

3. See, for example, *People v. Collins* and the law review literature surrounding it, including, for example, Finkelstein and Fairly (1970). See also Symposium (1986). I use fact finder as a generic term for judge, jury, auditor, and administrator: the arm of the state that receives evidence and metes out punishments and rewards accordingly.

legal fact finding. Under this view, a hearing is not a laboratory experiment. Its chief purpose is not to advance our knowledge of the world, but to affect how agents behave outside the hearing, in the workplace, and on the road. Any knowledge obtained in the process has only this instrumental value. (For an example of how focusing on primary activities changes the analysis of particular evidentiary rules, see the treatment of character evidence in Sanchirico [2001].)

The (classic) *Moral Hazard* approach to evidence production solves the second problem of the Bayesian approach, regarding incentives in the primary activity, but not the first problem, regarding incentives at the hearing.[4] The implicit analogy here is to the employer (rather than the scientist) who induces her employee to work hard by conditioning wages on an inanimate, noisy signal of work effort, usually understood to be firm output. The output signal is "noisy" in the sense that hard work occasionally leads to low output and laziness occasionally leads to high output. But in general, the signal is accurate enough to render feasible an output-contingent pay scale that makes it in the interest of the employee to work hard.[5]

The Moral Hazard approach is essentially a generalization of the enforcement approach devised by Becker (1968). In this model, detection is an imperfect signal of the underlying criminal act—both convictions and acquittals may be erroneous—and rewards and punishments are cast in terms of fines and incarceration. The Becker enforcement approach, and by implication the Moral Hazard approach, has become the most popular model of trial in the large literature on the Law and Economics of Procedure.[6] In the typical civil litigation model, for instance, individuals

4. Recent examples of this approach include Davis (1994), Hermalin and Katz (1991), and Schrag and Scotchmer (1994).

5. Typically, the mechanism is also constrained by the requirement that participation be individually rational for the employee.

6. This literature focuses on incentives to file and settle, modeling the trial end game in "reduced form" as a sort of random detection mechanism. Typically in these models, evidence production is packed into a single probability that the court will find the defending agent liable. And when the primary activity is also accounted for in such models, this probability is made to depend on agents' behavior in the primary activity. Thus, trial outcome acts as an exogenous signal of primary activity, just as output is an exogenous signal of the employee's effort. Also in the same category are models that focus on the determinants and effects of error on the random detection mechanism that represents trial. Such models differ fundamentally from the approach taken in this

decide whether or not to exercise care, understanding that less care is more likely to lead to liability.

As a model of procedure, the Moral Hazard approach has proven extremely useful. But as a model of evidence, which by definition must be explicit about how fact finders actually obtain the information on which to base rewards and punishments, it is incomplete. Whereas the employer's signal from our example is exogenously generated (conditional on the employee's choice of effort), the evidentiary signal received by the court is chosen by the agent—a choice separate from her decision of how to behave in the primary activity. Thus, the Moral Hazard approach still fails to take into account the agent's incentive, after she has chosen her action in the primary activity, to manipulate the signals upon which the fact finder conditions rewards and punishments.

The third approach to evidence production consists of the (pure) *Omission* model as typified by Milgrom and Roberts' (1986) well-known and often-cited article, "Relying on the Information of Interested Parties."[7] This approach does account for incentives at the hearing stage, but in a limited way, since it rests on the assumption that agents do not lie even when it is in their interest to do so.[8] The focus of this approach is on agents' incentives to withhold information that is against their interest. The "fundamental theorem" in the literature asserts that the fact finder can learn the full story from an agent who is truth-telling but not nec-

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article because they posit an exogenous relationship between the accuracy of the trial detection mechanism and either the level of public spending (see, e.g., Kaplow and Shavell, 1994, 1996), the primary activity behavior of the agents (see, e.g., Calfee and Craswell, 1984; and Craswell and Calfee, 1986, which are discussed in more detail in note 30) or the trial preparation effort of the parties (see, e.g., Katz, 1988; and Rubinfeld and Sappington, 1988, which is discussed in more detail in note 10).

7. See also Lipman and Seppi (1995), Okuno-Fujiwara, Postlewaite, and Suzumura (1990), Shavell (1989), and Sobel (1985). Recent advances in the law and economics of evidence that model evidence production in terms of "strategic search" also fall into this category. See, for example, Froeb and Kobayashi (1996) and Daughety and Reinganum (2000). In this literature, parties to a suit sample from a distribution for pieces of evidence, deciding both when to stop sampling and what of their sample to show the court. Parties may decline to report what they observe. But they may not fabricate observations. For a lengthier discussion of the literature modeling evidence as strategic search, see Sanchirico (2000, n. 4).

8. Some papers attempt to justify the no-lying assumption by mentioning that perjury is a crime. This just avoids the problem, however, for perjury itself requires evidentiary proof. Perjury is considered in more detail below.

essarily forthcoming by announcing beforehand that she will assume the worst for the agent on whatever points the agent leaves ambiguous or unmentioned. But the so-called "unraveling" argument that supports this conclusion itself unravels if the agent is capable of actually lying, for then the agent simply responds to the fact finder's rule with precise lies.[9]

1.2. Legal Evidence as Endogenous Cost Signaling: The Framework

In contrast to these three existing approaches to evidence production, this article analyzes the full double incentive problem, integrating incentives in both the primary activity and the subsequent hearing, in a model in which agents can and will lie when it is in their interest to do so. The idea is to view evidence production as costly signaling, á la Spence (1974). Unlike the typical signaling model, however, signaling costs here are not exogenous. Rather, it is crucial to the functioning of the model that the agent's hearing "type" (i.e., evidence production costs) is potentially affected by her choice of action in the primary activity.[10]

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9. The following example illustrates the points just made: The "truth," is a number between one and ten. The agent knows that the true number is three but wants the fact finder to think the number is as large as possible. The agent can omit to tell the principal all he knows, by reporting that the number is in some range (e.g., between two and five). But he cannot lie: the reported range must contain the number three. Reporting "between five and eight," for example, is not allowed. Suppose the principal then announces that she will act as if the truth is the lowest number in the range reported by the agent. Then it will be in the agent's interest to report a range whose lowest number is as high as possible. Since the reported range must contain three, the agent will always report an interval whose lowest number is three. Knowing all this, the principal learns the true number—and without cost. Of course, if the agent could lie, the principal's rule would just inspire the agent to report that the number is exactly ten.

10. This formulation resonates with several important papers: First, Rubinfeld and Sappington (1987) is the first paper to suggest that trial is under analyzed in the law-and-economics literature and, further, could and should be seen in terms of "signaling" by the parties. The present paper owes much to Rubinfeld and Sappington but differs in several important respects. (1) While Rubinfeld and Sappington suggest the idea of seeing trial as a signaling session (p. 308)—and even point toward evidence production cost differences as an important mechanism (p. 310)—such signaling is not actually modeled in their paper. Rather, defendant's unobserved trial effort is assumed to affect trial outcome according to a fixed function mapping defendant's trial effort (and the court's "prior belief" in defendant's guilt) onto the court's "posterior" assessment of guilt. How the defendant translates effort into evidence, and how the court translates

Thus, the analysis differs from the Bayesian and Moral Hazard approaches in that it shifts the focus from the correlation between evidence and underlying truths to differences in evidence production costs tied to differences in primary activity behavior. The model differs from the Omission approach because it allows that agents can and will lie whenever it is in their interest to do so, which in turn is what necessitates reliance on costly signaling as opposed to "cheap talk" disclosure.[11]

1.2.1. The basic mechanic. The gist of the model is apparent in the following simple example. A regulator wishes to induce firms to comply with a particular regulation, despite the fact that compliance costs firms an additional $100,000. The regulator requires that at the end of the period each firm appear before a review board to "present evidence" of its compliance. *Based solely on this evidence,* the review board then decides whether and

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evidence into an assessment of guilt are not actually modeled. In particular, there is no sense in which the court evaluates the defendant's signal transmission choice in a strategically sophisticated manner—as, for instance, the employer evaluates the applicant's educational degree in Spence's (1974) model of signaling. (2) Rubinfeld and Sappington do not consider how prospective trial rules and outcomes affect incentives in the primary activity (which in their model is the commission of crimes). Their model picks up the story at trial, after the defendant has either committed or not committed the crime. (On this second distinction, note that Rubinfeld and Sappington's focus on trial error is not isomorphic to an explicit treatment of the primary activity. See, for example, Schrag and Scotchmer's [1994] Proposition 1.) Correspondingly, Rubinfeld and Sappington neither suggest nor explore the idea of *endogenous* type signaling.

Second, an application of endogenous type signaling appears in Daughety and Reinganum (1995). In the Daughety and Reinganum model: research and development expenditure is the hidden action; product safety is the type; and, depending on the product liability regime in place, price may act as a signal of safety to consumers.

Third, endogenous type models of evidence can also be recast as a Holmstrom and Milgrom (1991) multitask principal agent problem with two tasks of varying observability (primary activity actions being completely *un*observed, evidence choice being completely observed). (I thank Andrew Newman for this suggestion.) It must be noted, however, that previous work on the multitask problem considers the danger of *substitution* into the observed and rewarded action at the expense of the unobserved action (e.g., the teaching of test-taking skills rather than creativity). In contrast, the model in this article operates by means of *complementarities* between the observable action (evidence production) and the unobservable action (in the primary activity).

11. Below I refine this distinction by reinterpreting the no-lying assumption in terms of extreme evidence cost differences.

how much to fine the firm.[12] One of the major points of this article is that in order for the regulator to induce compliance in this setting, it is both necessary and sufficient that the regulator identify some form of presentation or performance before the review board, some "evidence," whose production costs for the firm vary appropriately with the firm's compliance activity.

To illustrate that the appropriate production cost differences can be sufficient, suppose that compliance happens to lower the firm's cost of a particular presentation from $140,000 to $20,000. Let the regulator announce before the firm's compliance decision that it will fine the firm $130,000 unless it presents this evidence before the review board. How does the firm react? First, consider its choice of what to present to the review board contingent on whether it has complied. If it *has* complied, the presentation will cost $20,000, but saves $130,000 in fines; hence, the firm's "best case" would be to present the $20,000 evidence and avoid the fine. If it has *not* complied, the presentation will cost $140,000 to produce, which is more than it would save in fines; its "best case" now would be simply to show up and pay the fine. Therefore, the firm's prospective payoffs at the review board hearing will be −$20,000 if it complies, and −$130,000 otherwise. Consequently, compliance increases the firm's prospective hearing payoff by $110,000. Stepping back to the firm's choice in the primary activity, we see that this $110,000 benefit outweighs the $100,000 direct cost of compliance. Thus, the firm chooses to comply.

To illustrate that production cost differences are *necessary* for incentive setting, suppose the regulator made avoiding the $130,000 fine dependent

12. It should be clarified that I am folding into the "regulator" and its "review board" many conceptually distinct roles including: (1) the setting of the evidence/reward structure and (2) the implementation of this evidence/reward structure on a case-by-case basis. In many settings, of course, these roles are divided among different actors and institutions. A partial list of the actors that have a hand in the operation of federal criminal law, for instance, would include Congress, the United States Sentencing Commission, the Supreme Court (in the obvious role and as proposer of the Federal Rules of Evidence), the prosecutor, the district judge and, of course, the jury. An analysis of intragovernmental interaction, which this article is not, would focus on the interaction of the various actors that set the ultimate correspondence between evidence and liability/punishment. Much interesting work has been done on precisely this question. See, for example, Schrag and Scotchmer (1994). But since such issues are not my concern here, I adopt a "statist" perspective, viewing the collection of state actors as a single actor who determines all of the components that constitute the ultimate mapping from evidence to outcomes.

on a form of evidence whose presentation cost was always \$50 *regardless of the firm's compliance behavior.* Then the firm would always present the evidence at the hearing, regardless of its compliance choice, and its prospective payoffs at the hearing would always be −\$50. The hearing would then be irrelevant to the firm's compliance choice, and so it would make this choice solely according to the \$100,000 direct cost of compliance. Therefore, it would choose *not* to comply.

The same problem crops up if the designated evidence always costs the firm \$1,000,000. In this case, the firm would never present the evidence and would always lose \$130,000 at the hearing, regardless of its compliance activities; the hearing would again be irrelevant to its compliance decision. What is important is not that the evidence is costly to present, but that presentation costs tend to be lower following compliance.[13]

1.2.2. Evidence cost differences in practice. The costly signaling framework sheds light on several common forms of evidence. Consider parties' sponsorship of eyewitness testimony subject to cross-examination. True witnesses of the firm's compliance are chosen by fate and the laws of physics help to insure that their stories are mutually consistent even under unanticipated cross-examination. False witnesses need intensive coaching and may demand compensation for time and risk. Even when false witnesses would be worth paying for, their additional cost helps to counteract the direct costs of compliance and this in turn helps to induce the firm to comply. Similarly, expert testimony is a useful regulatory tool when the cost of gathering experts to support one's case increases along with the extent to which the expert must be induced to contradict her professional knowledge and judgment. The firm complies if compliance is less onerous than the extra expense of finding experts who are willing to attest to compliance when, in fact, there has been none.[14]

13. I am making the usual assumption that the regulator can precommit to carry out the costly hearing and collect the determined punishment, even though the agent will have already chosen her action in the primary behavior by the time the hearing is held. In my view, allowing for precommitment is more realistic than requiring "subgame perfection" when the relevant reward structures are set in large part by statute and precedent. In accordance with this notion, many state enforcement models, from Becker (1968) on, also assume that the state has the ability to precommit to the process it has prescribed.

14. See Sanchirico (2000, section 1.1.2.) for more on the practical manifestations of endogenous cost evidence.

1.2.3. What about perjury? Does the threat of perjury more simply explain how the state obtains the information necessary for effective regulation? Individuals tell the truth, this explanation would run, when the (increase in the) probability of being indicted for perjury if one lies, times the punishment for perjury, exceeds the benefits of lying. End of story.

Certainly this explanation would be simpler. But this is only because it avoids the difficult question. More precisely, it just slides the fundamental puzzle of evidence production back one proceeding. We still have to answer the question of how the state ascertains that the agent has perjured herself. If the answer is "based on evidence production at a collateral proceeding," then we have simply replaced the black box of evidentiary process with the black box of *collateral* evidentiary process.

Furthermore, the simple perjury explanation would probably not be more empirically accurate. What data there is suggests that prosecutors are reluctant to bring perjury charges, especially in civil cases. As a result, perjury is by many accounts commonplace—arguably more commonplace than could be reasonably balanced off against the severity of its punishment. It appears, rather, that the real work of sorting out which evidence is and is not reliable is done within the confines of the hearing itself, without much resort to the threat of ancillary process.[15]

15. In partial accordance with this paragraph, Posner (1999, p. 147) writes:

> Even judges have a certain ambivalence about perjury in civil litigation. It is not unusual for one judge to say to another that he or she has just presided at a trial at which several of the witnesses were obviously lying, or that the witnesses seem to have coordinated their stories or to have been "well coached" by the lawyers. I have heard expert witnesses referred to as "paid liars." These comments are generally not made in a tone of indignation, and they very rarely lead to a referral to the Department of Justice to inquire into the possibility of an obstruction of justice. Part of this reaction is due to the difficulty of proving perjury in most cases, and part to the fact that judges like other professionals grow moral calluses. But part is due to a sense that *the court system has been designed, or at least has evolved, to be robust in the face of the known inefficacy of the oath and of the threat of prosecution for perjury and other obstructions of justice and as result, the frequency of these crimes*. It would be nice if they were less frequent, but fortunately they are less costly to society, less feared and less dangerous than many other felonies. (emphasis added)

Harris (1996) uncovers similar phenomena in her interviews with prosecutors. She reports one prosecutor's statement that "if perjury were water, the people in civil court would be drowning." She explains further: "Prosecutors do not believe that [perjury] is a serious problem that they need to be concerned with. They point out that it is the jury's

This is not to say that the threat of a collateral proceeding could not under a different system play an important role in setting agents' incentives to produce evidence at the "primary hearing." Indeed, the collateral proceeding and the evidence there produced would operate on incentives in the primary hearing just as evidence production in the primary hearing operates on incentives in the primary activity.[16] Certain evidentiary presentations in the primary hearing (e.g., outright lies) would be discouraged to the extent that they made other forms of evidence (those establishing, for example, the defense of truth) more expensive at a later proceeding. It would then be an interesting question whether use of collateral proceedings—as opposed to reliance on dynamics internal to the primary hearing—were a cost-effective method of incentive setting.

I do not explicitly model the possibility of relying on collateral proceedings to create the requisite differences in evidence presentation costs at the primary hearing. Instead, I have chosen to include the incentives provided by such proceedings as one, albeit implicit, component of evidence costs at the primary hearing.[17] This choice is perhaps justified by the obvious complication that would result from adding yet a third stage to the model.

1.3. Implications of the Costly Signaling Framework

The costly signaling approach to evidence production proposed here has several implications that make it operationally (as well as conceptually) distinct from existing approaches.

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job as the factfinder to assess the credibility of witnesses and evidence and ascertain the truth. By the end of the trial, unreliable testimony and evidence have been rejected, truthful testimony and evidence considered, and an outcome determined" (p. 1771).

16. Indeed, there would in theory be an infinite regress, here, with "second order" collateral processes enforcing "first order" collateral process and so on.

17. See note 35 for the manner in which this manifests in the formal model. With respect to the first numerical example discussed in section 1.2.1, I implicitly account for perjury by leaving open the possibility that part of the noncompliant firm's relatively high presentation cost ($140,000 as opposed to $20,000) is due to the negative effect that such presentation would have on the firm's highest attainable payoff (which may itself be negative) at a collateral evidentiary proceeding that delved deeper into the details and circumstances averred in the primary presentation.

1.3.1. Truth's false ally. The first implication of this alternative view of evidence concerns the role of "truth" in litigation and enforcement. Evidence scholars have long recognized the presence of "truth's rivals"—reasons that the law declines to take the route most likely to lead to discovery of what actually happened outside the hearing room.[18] Among the most commonly cited rivals are the sanctity of certain socially beneficial relationships (consider the attorney-client privilege and the spousal privileges), fairness to and the dignity of litigants (consider Federal Rule of Evidence 404, which generally prohibits the use of character evidence to show behavior in conformity therewith on a particular occasion), and the alternative use of resources exhausted by the process of fact finding (cited in Federal Rule of Evidence 403 as a balance against probative value).

But it is conventional wisdom both in law and in law-and-economics that the truth does have at least one ally in the goal of deterrence. After all, if the fact finder never learns anything about what actually happened in the primary activity, how can the law possibly set rewards and punishments so as to encourage the desired behavior? Without some inkling of how the parties are likely to have actually behaved—however indirect and imperfect such information may be—the court might as well determine whether to punish or reward by flip of a coin. Or so it would seem.

Yet, in the model of evidence production proposed here, deterrence offers little assistance to truth in its battle against rival forces. In this model, deterrence does not require that the state learn anything at all about what actually happened in the primary activity. Thus, the hearing performance that would be staged by the negligent and the nonnegligent might be identical, thus providing the court with no means of distinguishing between them and therefore resulting in identical rewards and punishments—in terms of liability and damages. Yet negligence may still be deterred—so long as the hearing performance required for exoneration is sufficiently more expensive for the negligent than taking care in the first place.

In other words, the deterrent effect of litigation and enforcement proceedings is keyed to *overall* hearing payoffs, and these consist not just of the liability, recovery, and fine that are ultimately set by the fact finder on

18. See, for example, the recent Symposium (1997–98), entitled "Truth & Its Rivals: Evidence Reform and the Goals of Evidence Law."

the basis of what she learns from the evidence, but also on the evidence production costs of the parties, which the fact finder does not directly observe.

To make this more concrete, consider the numerical example from above. In that example, the evidence cost either $140,000 or $20,000, depending on whether the firm had been compliant, and the regulator announced that it would fine the firm $130,000 unless it presented the highlighted evidence. With this reward structure, only the compliant firm would present the evidence—so that the regulator would in fact learn whether the firm had been compliant. But the fact that the regulator learned the truth from the evidence was purely collateral. What mattered was the fact that the *hearing payoffs* were sufficiently higher for the compliant firm than for the noncompliant firm. And since evidence production costs differ, this does not require that compliant and noncompliant firms present different evidence.

Suppose, for example, that the regulator announced that the firm would be fined $150,000 if it did not present the evidence. Then *both* compliant and noncompliant firms would find it worthwhile to present the evidence, and the regulator would never learn whether a given firm had been compliant or not. On the other hand, the hearing payoffs for both firms would now consist solely of presentation costs, and the difference in these costs (between $140,000 and $20,000) would still be enough to induce compliance in the primary activity.[19]

19. Note that even though noncompliant firms would present the same evidence as compliant firms were they to come before the regulator, the regulator has set the evidence/reward structure so that in fact no noncompliant firms ever actually come before it. In this sense, then, the regulator does know the "truth" about compliance-not by virtue of the evidence it sees at the hearing, but by virtue of the manner in which it has associated evidence and rewards ex ante. This phenomenon does not, however, detract from my claim in this section that the incentive setting role of evidence production is logically distinct from its role in "revealing truth." In the first place, information gleaned by *conformity* of primary activity action in response to the ex ante evidence schedule is quite a different phenomenon from truths revealed by *differences* in evidence actually produced ex post. Only the latter describes the sense in which evidence production is conventionally thought to reveal truth. Second, such conformity of primary activity action is, in any event, an artifact of my simplifying assumption that all firms are identical. Suppose, for example, that there are two types of firms but that the difference between them is indistinguishable from the regulator's point of view: one liability per evidence schedule would have to be used for both. Imagine, further, that for one type of firm the cost of compliance is $100,000, whereas for the

One way to describe this phenomenon is to say that in the costly signaling model of evidence presented here, "pooling" can do the job just as well as "separation." This is one important way in which the costly signaling model of *evidence* differs from the classic costly signaling model. In the classic model, the principal's object in making use of costly signals is indeed to learn the private information currently in the possession of the agent. Thus, the employer would like to learn whether the employment candidate is of high or low ability—to reference Spence's (1974) seminal application of costly signaling—because she would like to hire only high-ability workers, or is willing to pay high wages only to high-ability workers. On the other hand, the *payoffs* of the workers in the signaling-choice problem solved by the employee are of no direct importance to the employer.[20]

In the evidence-as-signaling setting, however, the hearing payoffs of the agents that come before the review board or court are *all* that matter. Deterrence is effected if doing the wrong thing in the primary activity means that you do not (or are not as likely to) fare as well at the subsequent proceeding. What the court actually learns of how the agent behaved in the primary activity is of subsidiary importance, so long as—by whatever means, whether preparation costs or fines—misbehaving tends to reduce total hearing payoffs.

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other type it is $125,000. Quite plausibly, the state may wish to induce compliance from only the firm with low compliance costs. The same evidence as in the example in the text (with compliance-dependent costs of $140,000 and $20,000 for both types of firms), coupled with a liability schedule that charged $150,000 to all firms that failed to present this evidence, would induce compliance by only low-cost firms. To see why, note that all firms, compliant or not, would choose to present the evidence. Thus, compliance would save all firms $140,000 − $20,000 = $120,000 in evidence costs, which makes compliance worthwhile for only low-cost firms. As a result, some of the firms coming before the regulator would be compliant, others would not. The regulator would be doing its job of inducing the right firms to comply, though it would be learning nothing about which of the firms before it were actually compliant.

20. Pooling is a common phenomenon in "equilibrium settings," where both principal and agent are imagined to move simultaneously, or where the principal's behavior is shaped by outside forces. Consider, for example, the pooling equilibria that attain in Spence's (1974) own model, which, notwithstanding my simplified description of it here, imposes a market equilibrium condition on wages. But in settings such as in the current paper, where the principal moves first in Stackelberg fashion without any form of feedback equilibration, pooling is a much less common modeling outcome.

This feature of the costly signaling approach to evidence also distinguishes it from the Moral Hazard approach to enforcement, especially as manifest in the well-known and often-applied Becker (1968) model. Incentive setting in that model rests on the assumption that the state's glimpse of the truth will be clear enough that fines can be set so as to have a differential effect on the agent that is sufficiently correlated to the agent's actual behavior. The Becker model certainly allows for errors—errors of both false exoneration/acquittal and false liability/guilt—but deterrence cannot be effected if errors exceed some threshold whose magnitude depends, in the simplest setting, on the relative sizes of the maximal fine and the private benefits of misbehaving.[21] Compare this to the numerical example of the costly signaling model, as just described. There, the chance that the court would learn anything was zero. From the court's perspective (though not the system's perspective), bad and good behavior are completely indistinguishable.

This is all to say that truth finding is not *necessary* for deterrence. However, the most efficient method of deterring will generally entail some amount of separation in evidence production. Importantly, the separation will typically not be total. And to the extent that some separation is optimal, this will not be because of the additional information that such separation gives the principal about what actually happened, but rather because of the cost savings that separation will in some instances make possible. Indeed, since no amount of separation is necessary for deterrence and yet some amount will be system cost minimizing, it must be that learning more is cheaper for the principal. Moreover, it must be that reducing costs is the only purpose of learning more. The relationship between truth finding and system costs in this model is thus almost backwards from that in the Moral Hazard/Becker model. In that model, more truth finding (a less imperfect signal) imposes higher costs on the system but may be necessary

21. Thus, if the benefit of the crime is \$10,000, fines cannot exceed \$100,000, the probability of false acquittal is p, and the probability of false conviction is q, then the expected fine if the crime is committed is $(1-p)$ \$100,000, and the expected fine if the crime is not committed is q \$100,000. The crime is deterred only if the amount by which good behavior reduces the expected fine, $(1-p)$ \$100,000 $-q$ \$100,000 = \$100,000$(1-p-q)$ exceeds the benefit of the crime \$10,000. Accordingly, the sum of the errors $p+q$ cannot exceed 90%. In other words, there has to be at least a 10% chance that the fact finder correctly distinguishes the guilty from the innocent.

for implementation. Here, truth finding is unnecessary for implementation and occurs only when, and only because, it *saves* on system costs.[22]

1.3.2. Perfect isn't good enough. As already noted, the Omission approach to evidence production does not—at least on its face—account for agents' incentive to lie. But there is an ingenious way to reinterpret the Omission approach in terms of the costly signaling perspective proposed here, and this reinterpretation does, technically speaking, explicitly account for lying.[23] One simply posits the existence of "perfect evidence": some package of evidence whose presentation is of infinite cost in states of the world other than that which such evidence is meant to indicate. Then lying—i.e., presenting the perfect evidence in other states of the world—is theoretically conceivable but practically impossible.

But the assumption that perfect evidence exists—let alone that it is an important enough factor in evidence production to warrant independent

22. While incentive setting by evidence production does not require "truth finding," it does require *information*. In particular, properly setting incentives both in this model and in the world requires that the state possess information about the private and social costs of primary activity actions, as well as the tendencies of primary activity actions to make certain types of performances before the court more or less costly to effect. Yet it is crucial to distinguish this later type of information from the sort of information that would be discovered through the fact-finding process and is typically associated with the evidentiary notion of "truth finding." In particular, the information relevant to the system I have described may be divided into two types: (1) *statistical knowledge* of key functional relationships, such as that between primary activity actions and evidence costs; and (2) *particular knowledge* of the level of relevant variables for a given firm, such as a given firm's compliance behavior. The sort of information that the regulator does or does not discover at each hearing is particular knowledge; the sort of information that it would need to set the system up in the first place is statistical. The focus in this paper is on problems due to lack of particular knowledge. This focus has substantial precedent in the literature. (Consider, for example, optimal taxation and the canonical principal-agent problem). One reason for the focus here and in the literature is that statistical knowledge is more easily obtained than particular. The exercise of gathering statistical knowledge is generally not prey to the serious strategic-revelation problems that are inherent in obtaining particular knowledge. If we ask a particular firm whether it has complied, and the firm knows that we will use this information to set its punishment or reward, then the firm has a compelling incentive to lie. On the other hand, if we ask each firm in an industry about the functional relationship between the primary activity and the cost of various forms of evidence, each individual firm realizes that its answer is just one of many data points for use in the design of a system that it may never encounter.

23. I thank Kathy Spier for suggesting this reinterpretation.

study—is arguably no more plausible than the assumption that agents cannot lie. The advisory committee's notes to the Federal Rules of Evidence boldly assert that "no class of evidence is free of the possibility of fabrication." (Rule 801(a), advisory committee's note). And even if this is overstatement, in practice most available evidence consists of oral testimony, documents, media, and the occasional physical article—all of which are forgeable, at a price.[24]

Even if one could plausibly argue that (near) perfect evidence were readily available for use by the system, it is another matter to support the claim that it should actually be employed. Indeed, the model presented in this paper—which as we have seen can accommodate the *possibility* of employing perfect evidence—tends to eschew its use in actual practice. In particular, the model's emphasis on minimizing evidence production costs—a factor absent from both the Omission approach and its reinterpretation—brings to the fore the fact that setting incentives by own-party evidence production is socially expensive. This then leads one to evaluate evidence not just by whether it can "do the job" but also by how much using it to do the job will cost society.

Seen in this light, perfect evidence is unlikely to be the best available. "Less perfect" evidence that is just sufficiently more costly for disobedient actions is likely to be cheaper all around and thus a more efficient means of setting incentives in the primary activity. Thus, in the numerical example discussed above, both \$20,000/\$140,000 evidence and \$20,001/\$140,000,000,000,000 evidence can be used to set incentives (with liability set at \$210,002 in the latter case). But the former, "less perfect," evidence does the job at lower cost.[25]

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24. Is not the fact that the plaintiff is missing a leg essentially perfect evidence, given that the cost of cutting off one's leg is near infinite? Yes, but the question is: perfect evidence of what? Plaintiff's presentation of severe injuries to the fact finder is perfect evidence only of the bare fact that the plaintiff appears before the fact finder with the injury. The existence of these injuries says nothing about how they were caused-e.g., whether the injury was caused by the defendant's lack of care. Information on how phenomena were *caused*, not just what they are, is crucial to the task of regulating behavior.

25. Note that what is being said here goes beyond the statement that there is a tradeoff between accuracy and cost. Even though \$20,001/\$140,000,000,000,000 evidence is more difficult to falsify, any cost difference over and above \$110,000 (the difference in primary action costs) is superfluous. Thus, there is, over this range, *no* tradeoff between accuracy and evidence cost; higher-cost evidence buys nothing of value.

Why would less perfect evidence tend to be less expensive all around? Certainly, no such relationship falls out of the bare logic of costly signaling: in the example above the perfect evidence might have had cost structure \$2/\$140,000,000,000,000. Nonetheless, the relationship is inherent in the manner in which "pieces" of evidence are typically "stacked" to produce the overall evidentiary performances upon which rewards and punishments are based. Despite my shorthand usage of the term, "evidence" is of course rarely a single performance or presentation, but rather a conglomeration of many different component performances.[26] A firm's evidence will typically consist of multiple witnesses or documents, or both. Each component performance has a cost for noncompliant firms and, if it is of any use in setting primary incentives, a lesser cost—though still a cost—for compliant firms. Increasing the relevant presentation cost *difference* is typically accomplished by increasing the number of "pieces" of component evidence required for full or partial exoneration. And this produces, as well, greater costs all around. Thus, two "pieces" of evidence, each with cost structure \$10,000/\$100,000, and so cost differences of \$90,000, may be combined to produce an evidentiary performance with cost structure \$20,000/\$200,000.[27] This combination performance generates a larger cost difference of \$180,000, but at a larger cost to the compliant of \$20,000.

The direct relationship between perfection and cost is often evident in practice. Before issuing a new license, for example, Departments of Motor Vehicles typically require only a passport and an expired license to prove identity. Requiring additional forms of identification, several witnesses, and DNA test results would increase the cost of forgery, but also the costs of truthful presentation.

Such cost considerations, central to the model in this article, are essentially ignored under the Omission approach to evidence: even if presentation costs are used to justify the Omission model's key no-lying assumption, they still have no role in how that model is solved.

1.3.3. Getting more for less. Another distinguishing implication of the model in this article concerns the optimal choice of which action to target

26. See note 34 for the manifestation of this point in the formal model.

27. I have assumed perfect additivity here. But, any additional cost for producing the two rather than either individually suffices for the point.

in the primary activity. Naturally this choice is informed by the marginal cost of implementing each potential action. If the marginal cost of inducing more intensive compliance activities is positive, for instance, it will be optimal to demand less of agents (relative to what would be demanded of them were implementation costless, for example). This is indeed the result that is obtained in the classic Moral Hazard/Becker model of enforcement, in which the wealth-constrained agent's disobedience is detected with some probability that is a function of either the state's expenditures on detection (in, e.g., a criminal setting) or the opponent's trial preparation effort (in a civil setting).[28] The optimality of underdeterrence in the Moral Hazard/Becker model continues to be important in current research on litigation and enforcement.[29]

In the model offered here, however, the underdeterrence result is turned on its head. Somewhat surprisingly, the marginal cost of implementation will tend to be negative (in the relevant range), implying that requiring *additional* compliance activities would be optimal.

The reason that implementation costs tend to decline in the private cost of the behavior implemented in the primary activity relates to the basic mechanic of costly evidence production. The agent is induced to take more care, for instance, because the evidence used by the court or review board to sort out liability or recovery tends to be less expensive to present the more care she takes. This means that (abstracting from changes in the evidence employed in setting different incentives) higher levels of care are associated with lower evidence costs for the agent, and this dynamic is

28. To understand why implementation costs increase in the standard model, suppose the state is currently implementing middling care at least cost. This means that it must be setting fines at their maximal level so that the probability of detection, which is directly tied to enforcement costs, is as low as possible. It also requires that the increase in expected fines that results from being careless outweighs the cost savings from reducing care effort to zero. Now imagine that the state wishes to increase the enforced level of care. This requires creating an even bigger increase in expected fines for careless behavior since the cost of the target care level is greater for the agent. But since fines are already maximal, this increased difference must come from increasing the probability of detection, and this means that enforcing the higher level of care will impose greater social costs.

29. For example, Polinsky and Shavell (1998) employ an interesting dynamic variant of the Moral Hazard/Becker model to show that imposing higher sanctions on repeat offenders may increase deterrence relative to a world in which sanctions are independent of offense history. As they make clear, increasing deterrence improves social welfare because underdeterrence is optimal with uniform sanctions.

what produces the tendency of implementation costs, inclusive of evidence production costs, to decrease.

In somewhat more detail, implementation costs "tend" to decrease in the same way that demand "tends" to decrease in price. In particular, the slope of the implementation cost schedule can be decomposed into two effects: the "change in presenter effect" (just described) and "the change in case effect" (the fact that different evidence may be used to induce higher levels of care). Similar to the substitution effect on demand, the change in presenter effect is always strictly negative for all parameter values and functional forms. On the other hand, the change in case effect is, like the income effect, patently ambiguous.

This result may have implications for the ongoing debate over tort reform. One of the most rhetorically powerful claims marshaled against current systems is that they "overdeter," causing agents to take too much care.[30] Yet the model proposed here suggests that claims of overdeterrence should be viewed with skepticism. To the extent that evidence production is an important element in the current system of litigation, "too much" care may be just the right amount.[31]

The remainder of the paper is organized as follows: section 2 presents the formal model. It then introduces three questions: (1) When is an action implementable with evidence production? (2) Given that an action is implementable, how is it implemented at least cost? (3) Given the least-cost implementation of all actions, which action should be implemented?

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30. Kessler and McClellan (1996), for instance, lend careful empirical support to the claim that the threat of suit causes doctors to practice "defensive medicine." They seem to define overdeterrence relative to optimal deterrence without accounting for implementation costs. Their argument still applies, however, under the classic model of enforcement, where optimal deterrence when implementation costs are taken into account is even less than it is when implementation costs are ignored.

Calfee and Craswell (1984) and Craswell and Calfee (1986) find that agents may overcomply (relative to the first best standard) when the probability of liability is a function of the level of compliance and damages are set equal to harm caused. They further establish that the problem is only exacerbated, if, as is traditionally advocated, damages are adjusted upward to compensate for the probability that offenders are not caught.

31. Hadfield (1994) studies the implications of varying levels of judicial competence arguing that overcompliance may be optimal when the alternative is the under-compliance brought on by the absence of judicial enforcement. The present paper shows that overcompliance tends to be optimal along the full continuum of judicial involvement.

Section 2 presents results on each of the three questions. The results are chosen to highlight the differences, in concept and implication, between existing approaches to evidence and the perspective proposed here. All formal proofs appear in the Appendix.

2. Formal Results

2.1. The model

A risk-neutral agent and a risk-neutral principal interact in a model with three phases.[32] To fix ideas, we will think of the principal as a *regulator* and the agent as a *firm* engaged in an activity that is potentially hazardous to local residents. In the first *promulgation phase*, the regulator announces a *liability (per evidence) schedule* $l(e)$. The schedule tells the firm how much it must pay in fines based on the *case or evidence* $e \in E$ it presents at the *hearing*, the third phase, described below. I impose no mathematical structure on the set E. In the primary activity, the firm chooses an action i (e.g., a care level). The firm's *private cost* for action i is a_i, where $a_1 < a_2 < \cdots < a_I$. The *social cost* (excluding the firm's private costs) is h_i. Only the firm observes its actual choice of action; the regulator receives no exogenous signal of the firm's choice of i.

Some time after its choice of action, the firm appears before the regulator's review board at a hearing.[33] There the firm chooses what case e

32. See Sanchirico (1998) for more detail on the mathematical structure of the model. Sanchirico (1998) also contains three illustrative functional form examples of the framework.

33. The structure described herein is similar to reporting requirements under the Clean Air Act, section 7414(a):

> The EPA Administrator may require any person who owns or operates any emission source ... on a one-time, periodic or continuous basis to (A) establish and maintain such records; (B) make such reports; (C) install, use, and maintain such monitoring equipment, and use such audit procedures, or methods; (D) sample such emissions (in accordance with such procedures or methods, at such locations, at such intervals, during such periods and in such manner as the Administrator shall prescribe); (E) keep records on control equipment parameters, production variables or other indirect data when direct monitoring of emissions is impractical; (F) submit compliance certifications ... and (G) provide such other information as the Administrator may reasonably require.

to present, balancing the resulting liability under $l(e)$ against the costs, if any, of presentation. The set E contains all possible "performances" that the firm could stage before the court.[34] This includes, for example, the case that consists solely of the cheap talk statement, "We were careful." Importantly, I also allow the possibility that some cases are costly and that—more to the point—the level of these costs is (probabilistically) affected by the firm's choice of action in the primary activity.[35] The *evidence cost schedule* for the firm is thus $c_{is}(e)$, where i is the firm's action and s is the *state*. The state s is drawn from the set of possible states S according to probabilities $(p_1, \ldots, p_S) > 0, \sum_s p_s = 1$.[36] I will refer to pairs (i, s) as *circumstances*. Importantly, the dependence of evidence costs on actions is not imposed, only allowed: the model encompasses the situation where for every case e, $c_{is}(e)$ is constant across i. The firm learns the actual value of s after choosing its action i, but before choosing its evidence e. The regulator receives no exogenous signal about the actual value of s. All functional relationships are common knowledge.

Thus, the firm chooses what precautionary procedures to follow in its production process with an understanding of how this choice tends to affect what actually comes to pass at the factory and in the neighboring town—for example, whether an industrial accident occurs, and if so, what part of it is observed by workers and neighbors, what pieces are left on the ground, what documents attest to the cause, and so on. Uncertainty in the causal relationship between care and incident is modeled by including the random component s. This component represents all relevant aspects of the environment known to the firm, but not affected by the firm's choice of care level—for example, unavoidable human or machine error, or whether someone happens to be watching the factory from a nearby window. The firm's choice of i and nature's choice of s together determine what actually happens at the plant and in the town. The model allows for the possibility

34. In accordance with the discussion in section 1.3.2, the set of such performances should be taken to include composite "performances" in which a number of evidentiary presentations are "stacked" to form a whole. This is why I refer to elements of this set of performances as "cases" rather than "evidence."

35. As discussed in section 1.2.3, the cost of a presentation may include expected payoff differences from a collateral perjury hearing.

36. Even though p is fixed across actions, the model does in fact allow for the case in which each action produces a different distribution over evidence cost schedules. See Sanchirico (1998).

that what actually happens at the plant and in the town affects in turn the costs of staging various performances before the review board, taking into account both casting (witnesses) and props (real and documentary evidence).

A primary activity action i and an *evidence plan* $(e_1, \ldots, e_S)$ are *incentive compatible*, given liability schedule $l(e)$, if they minimize the firm's costs $a_i + \sum_{s=1}^{S} p_s(l(e_s) + c_{is}(e_s))$. This requires a fortiori that the evidence e_s to be presented in each state minimizes liability and production costs, given the chosen action. The regulator's *overall problem* is to choose the liability schedule $l(e)$ to minimize *system costs*, $a_i + h_i + \sum_{s=1}^{S} p_s c_{is}(e_s)$, where i and $(e_1, \ldots, e_S)$ are the action and evidence plan that are incentive compatible with $l(e)$.[37] When i and $l(e)$ satisfy the incentive-compatibility constraint with some evidence plan, we will say that $l(e)$ *implements* i, meaning that rewarding evidence in this manner induces the firm to take action i. Action i is said to be *implementable* if we can find some $l(e)$ implementing it.

The regulator's subproblem of implementing a fixed action i at least cost is to choose a liability schedule $l(e)$ under which action i is incentive-compatible, so as to minimize *hearing costs*, $\sum_{s=1}^{S} p_s c_{is}(e_s)$, where $(e_1, \ldots, e_s)$ is the evidence plan that is incentive compatible with $l(e)$.[38] Solving this subproblem, given action i, yields the *(minimal) cost of implementing* i, which we denote as C_i. (Set $C_i = \infty$, if i is not implementable.) Action i is said to "solve" the overall problem if, and only if, it minimizes $a_i + h_i + C_i$.[39]

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37. For ease of exposition the problem is here stated in a manner that is not technically complete. The statement neglects the possibility that there will be more than one action/evidence plan pair that is incentive-compatible for a given liability schedule. As is standard, I implicitly allow the regulator to choose which incentive-compatible action and evidence plan the agent will follow. See Sanchirico (1998) for the complete statement of the problem. Also note that more than one liability schedule may be optimal.

38. See Sanchirico (1998) for the technically complete statement of the subproblem.

39. I impose no budget-balance constraint on liability payments (which may be negative). However, translating the liability schedule up or down by a fixed constant has no effect on the constraints or the objective. Thus, the principal can always obtain *expected* budget balance, given the implemented action i, by translating $l(e)$ so that expected net liability payments are zero. Given a large population of agents, the principal can achieve almost sure budget balance if the state s is drawn in a manner that allows application of a law of large numbers.

2.2. Roadmap for Formal Results

The regulator's problem poses three issues, all of which relate to important differences between existing approaches to evidence and the model here proposed.

Implementability. When is it possible for the regulator to induce the firm (agent) to take a given action in the primary activity solely by observing the evidence that the firm presents at the hearing? That is, when can we find some liability schedule implementing a given action i? The main point to be made here is that cost differences are necessary (Proposition 1) but truth finding is not (Proposition 2).

Minimal-cost implementation. Given that an action can be implemented by some liability schedule, what is the cheapest way to do so in terms of evidence costs actually incurred? This is the regulator's (principal's) subproblem. Here it is shown that "perfect evidence," as formally defined within, is never part of the minimal-cost implementation (Proposition 3), and that minimal-cost implementation typically entails limited separation (truth finding) (Proposition 4).

Which action to implement. Given the cheapest way to implement each implementable action, which action should the regulator choose? The main point here is that the best course is likely to be implementing an action whose private costs exceed those of the action that would be chosen if hearing costs were not accounted for (Proposition 5).

2.3. Implementability

2.3.1. The necessity of cost differences. The following result establishes the central role of production cost differences.

Proposition 1. No action in the primary activity, except the action of lowest cost to the agent, is implementable if evidence costs do not vary in action; that is, if for all states $s = 1, \ldots, S$, all pairs of actions $i, i' = 1, \ldots, I$, and all evidence e, $c_{is}(e) = c_{i's}(e)$.[40]

The basic idea behind the result has two logical steps. Consider first the firm's choice of evidence at the hearing. The firm balances two considerations: the cost of presentation (if any) and the extent to which the

40. A more general result is proven in the Appendix.

presentation will change the fact finder's ruling in its favor. Hypothetically, two firms with the same evidence costs who face the same liability schedule will end up with the same payoffs from the hearing. Their optimization problems are the same. Therefore, their best possible payoffs are also the same.

Now, step back in time to the firm's choice of action in the primary activity. In choosing whether to comply, the firm balances its private costs against its forecast of how taking care will improve the best it can do at the hearing. The fact finder induces compliance only when the firm believes that compliance increases how well it can do at the hearing by more than the direct cost of complying. But by the reasoning in the previous paragraph, complying improves the firm's hearing payoffs only if it changes, to the firm's benefit, the optimization problem that the firm faces at the hearing. Since the liability schedule $l(e)$ is fixed with respect to actual compliance, any favorable change must come via a favorable shift in evidence costs. Conversely, if the firm's evidence costs are fixed with respect to compliance, then so are the firm's best possible hearing payoffs. All "evidence" is therefore "cheap talk" and has no effect on compliance incentives. In this case, the direct cost of compliance is the only consideration in choosing whether to comply, and thus the firm is always noncompliant.

2.3.2. The sufficiency of ignorance. The following result establishes that truth-finding (i.e., "separation" as opposed to "pooling") is logically superfluous to the issue of implementability. (The role of truth-telling in *minimal* cost implementation is considered in the sequel.)

Proposition 2. If the set E of available evidence is sufficiently rich, that is if the function $(c_{11}(e), \ldots, c_{IS}(e))$ is onto[41] $\mathbb{R}^{I \times S}$, then every action i can be implemented with a liability schedule under which the firm (agent) presents the same evidence in all circumstances, implying that the regulator (principal) never receives any information about the true circumstance.[42]

41. Technically, this means that for every $I \times S$ dimensional vector x there exists an e such that $(c_{11}(e), \ldots, c_{IS}(e)) = x$. This condition is actually much stronger than necessary, but weaker conditions are more cumbersome to state.

42. A more general result is proven in the Appendix.

2.4. Minimal-Cost Implementation

2.4.1. When perfect isn't good enough. In this section, I show that "perfect evidence" is never used in any cost-minimizing implementation. In particular, I demonstrate that the cost of "forgery" is bounded. For this result I assume only that evidence is "divisible" and that the set of possible evidence includes the presentation of no evidence. Evidence is *divisible* in circumstance (i, s) if, arbitrarily close to any evidence with strictly positive cost in circumstance (i, s), there exists evidence with strictly lower costs.[43] And evidence is *divisible* generally if it is divisible in all circumstances (i, s). Thus evidence is divisible if it is possible to restructure any presentation to shave off production costs. Evidence is often divisible along a time dimension: one can always coach a sponsored witness one minute less, or search one minute less for corroborating documents. *Do-nothing evidence* $0 \in E$ is evidence that is of minimal cost in all circumstances and has the same cost across all circumstances.[44] Showing up and remaining silent is prototypical do-nothing evidence. I allow the uniform cost of do-nothing evidence to be positive to account for the possibility of fixed costs.

Proposition 3. Suppose that liability schedule $l(e)$ implements action i at minimal cost and that e_{is} is the evidence the firm presents in state s after taking action i. In at least one other circumstance (i', s'), the cost of presenting evidence e_{is} will be no more than $(a_i - a_1)/p_s$ greater than the cost of presenting evidence e_{is} in circumstance (i, s).

2.4.2. When learning more costs less. It was previously shown that truth finding is not necessary for implementation. However, truth finding—i.e., separation—will often play a role in the minimal-cost implementation of a given primary activity action. Importantly, this is not because of the additional information that such separation gives the principal, but because of the cost savings that separation makes possible.

To understand how truth finding can save on system costs, imagine that we start with a situation like those examined in Proposition 2, in

43. Formally, $\forall e \in E$ such that $c_{is}(e) > 0$, $\forall$ open neighborhoods $U(e)$ of e, $\exists e' \in U(e)$ such that $c_{is}(e') < c_{is}(e)$. Openness is defined with respect to the coarsest topology under which c_{is} is continuous.

44. Formally, $\forall (i', s')$, $c_{i's'}(0) = \min_e c_{i's'}(e) = F \geq 0$.

which we are implementing a given action i with the firm presenting the same evidence e in all circumstances. The liability schedule inducing uniform presentation of e must be such that failure to present e results in an increase Δl in the firm's liability that exceeds its presentation costs for e—and this must be true in every circumstance.

Now, consider the circumstance(s) in which this evidence e is most expensive for the firm. Instead of having the firm present e in this circumstance, we can instead induce it to present no evidence by reducing the increase in liability Δl so that it is slightly less than the firm's presentation cost. The firm will then present no evidence in this highest-cost circumstance, but its hearing payoffs in this circumstance will be essentially the same. Further, the firm will continue to present e in all other circumstances: we will not have reduced Δl below the cost of presenting e in circumstances besides that in which e is of highest cost. Thus, hearing payoffs in all these other circumstances also will remain unchanged. Since hearing payoffs are essentially the same, the firm will still choose action i in the primary activity. The fact that the firm will not be presenting e in the circumstance in which it is of highest cost has two implications. First, since this circumstance has at least some chance of occurring, system costs will be lower. Moreover, now the principal will learn whether the highest cost circumstance has or has not obtained—rather coarse information, given the full range of circumstances, but more than the principal was receiving at the start. The result: learning more has lowered system costs.

What is the optimal amount of separation in evidence production? Fully general results are difficult to obtain. But for *multiplicatively separable evidence costs,* evidence costs of the form $c_{is}(e) = \zeta_{is}c(e)$ for some function $c(e)$, the results are stark and illustrative. The proof for the following result is lengthy and appears in Sanchirico (1998).

Proposition 4. Suppose that evidence costs are multiplicatively separable. Then in any minimal-cost implementation of any action $i > 1$ no more than I different pieces of evidence will be used, even though there are $I \times S$ different circumstances.

In interpreting this result, note that there is no sense in which individual actions will be associated with individual pieces of evidence: only the total

numbers of each are associated. In particular, there will generally be no one-to-one correspondence between the I evidentiary presentations and the I actions: for instance, a given action may be the most probable after several different presentations.

2.5. Which Action to Implement: When Deterring More Costs Less

This section explicates the tendency for the optimally implemented action to exceed the action that minimizes social costs $a_i + h_i$ in the primary activity. To aid in the exposition, I will assume throughout that all actions are implementable.[45] Let us say that action i is *first best* if it minimizes $a_i + h_i$ and *second best* if it minimizes $a_i + h_i + C_i$. The first step is to establish the relationship between the slope of C_i and the relative size of first and second best actions.

Lemma 1. Suppose that implementation costs are decreasing across all actions greater than $i = 1$: that is, given i and $2 \leq i' < i$, $C_{i'} > C_i$. Then if $i^{SB} \geq 2$ is second best and i^{FB} is first best, it must be that $i^{SB} \geq i^{FB}$.

I now decompose the slope of the minimal-cost-of-implementation schedule into two effects. Suppose that liability schedule $l(e)$ implements action $i \geq 2$ at minimal cost whereas $l'(e)$ implements some lower action $i' < i$ at minimal cost. Let $(e_{11}, \ldots, e_{IS})$ and $(e'_{11}, \ldots, e'_{IS})$ represent the respective incentive compatible evidence plans. Then by simply adding and subtracting the term $\sum_{s=1}^{S} p_s c_{i's}(e_{is})$, the net increase in implementation costs caused by increasing the implemented action from i' to i, namely $C_i - C_{i'} = \sum_{s=1}^{S} p_s c_{is}(e_{is}) - \sum_{s=1}^{S} p_s c_{i's}(e'_{i's})$, can be additively decomposed into (1) the *change-in-presenter effect*, $\sum_{s=1}^{S} p_s(c_{is}(e_{is}) - c_{i's}(e_{is}))$, and (2) the *change-in-case effect*, $\sum_{s=1}^{S} p_s(c_{i's}(e_{is}) - c_{i's}(e'_{is}))$. This decomposition says that two things happen when we raise the level of care that we are implementing from i' to i. First, fixing the evidence plan actually employed, we raise the action that is actually presenting the evidence. This corresponds to the change-in-presenter effect. Secondly, we shift the evidence per liability schedule from one that minimizes costs in implementing i' to one that minimizes costs in implementing i. This will

45. See Sanchirico (1998) for the more general case.

generally entail a change in the evidence plan actually employed by the agent. The resulting change in expected costs, fixing the action taken at i', is the change-in-case effect.

Proposition 5. The change-in-presenter effect $\sum_{s=1}^{S} p_s(c_{is}(e_{is}) - c_{i's}(e_{is}))$, where $i' < i$, is always strictly negative.

The intuition is as follows. In order to implement i over the lower i' we must be rewarding the agent with higher expected hearing payoffs if it takes action i instead of the less privately costly action i'. A fortiori, the agent must do at least as well if it obediently takes action i and honestly presents e_{is} in each state s, than if it *dis*obediently takes action i' and then dishonestly mimics an obedient agent at the hearing, presenting e_{is} (as opposed to $e_{i's}$) in each state. (There may be even more profitable ways for the disobedient agent to be dishonest at the hearing.) Since private costs are strictly higher for the obedient and honest agent, it must be that the obedient and honest agent's expected hearing payoffs are strictly higher than those of the disobedient and dishonest agent. Since both agents present the same evidence in each state, they obtain the same liability in each state. Thus, the obedient and honest agent's expected hearing payoffs can be higher only if his expected evidence costs are strictly lower. (Note that we cannot conclude that his evidence costs are strictly lower in any given state.)

While the change-in-presenter effect is always negative, the change-in-case effect may go in either direction. In the Appendix, I provide a simple and natural example in which the effect is negative, reinforcing the change-in-presenter effect and ensuring that the second best exceeds the first.[46]

3. Conclusion

Many forms of regulation rely in whole or in part on information supplied by the party in interest. Yet, despite simultaneous advances in both law-and-economics and information economics, the academic literature

46. The change-in-case effect will always be *non*negative when evidence costs satisfy a single-crossing property. See Sanchirico (1998).

still lacks a full account of this problem—that is to say, an account that not only integrates incentives in the primary activity and the subsequent hearing but also acknowledges that agents can and will lie when it is in their interest to do so. This paper has set out to remedy that deficiency. Though much work remains to be done, the model proposed makes several points that taken together represent a conceptual shift in the way evidence has been viewed both in law and in economics.

First, in a world in which agents can and will lie, evidence is of use in inspiring care on the street or in the factory only to the extent that the exercise of care lowers presentation cost in the hearing room. Second, this being so, enforcing higher levels of the action in the primary activity turns agents into lower-cost evidence producers and may reduce the cost of implementation—a result that calls into question recent claims that the tort system "overdeters." Third, the central role of evidence costs makes clear that the best evidence is not necessarily the most "conclusive." Presentation cost differences are necessary to implement a given action, but the absolute level of evidence costs for the implemented action is also an important factor. Thus, "perfect evidence" may be inferior to relatively forgeable evidence that costs significantly less when genuine. Lastly, the relationship between truth finding and deterrence is far more tenuous than has been supposed. The importance in effecting deterrence of truth-finding *per se* is called into question. If the central object of the hearing is to set incentives on the road or at the plant, then it is of no direct concern whether the petitioner is telling us "the truth", what matters is only whether what she tells us tends to be more difficult to say when she has failed to act as the law requires.

Appendix

It is more convenient to work with an alternative formulation of the regulator's problem whose equivalence is established below. In this alternative formulation, we proceed as if the principal chooses both the agent's action and her evidence and liability in each circumstance, subject to *two* respective incentive constraints, one for the primary activity and one for the hearing. We represent the choice of liability and evidence in each circumstance by a vector rather than a function. We refer to this vector also

as the liability-per-evidence schedule. Thus, the principal's *direct bifurcated problem* is to choose i and $(l, e) = (l_{11}, \ldots, l_{IS}; e_{11}, \ldots, e_{IS})$ to minimize $a_i + h_i + \sum_{s=1}^{S} p_s c_{is}(e_{is})$, subject to: $\forall i' = 1, \ldots, I$,

$$a_i + \sum_{s=1}^{S} p_s(l_{is} + c_{is}(e_{is})) \leq a_{i'} + \sum_{s=1}^{S} p_s(l_{i's} + c_{i's}(e_{i's})), \tag{1}$$

and $\forall(i', s'), (i'', s'')$,

$$l_{i's'} + c_{i's'}(e_{i's'}) \leq l_{i''s''} + c_{i's'}(e_{i''s''}). \tag{2}$$

Constraints (1) and (2) constitute a bifurcation of the incentive-compatibility constraint. Constraint (2) says that if the agent were to take action i' and observe realization s', it would (weakly) prefer the liability and evidence pair $(l_{i's'}, e_{i's'})$ to that assigned to every alternative circumstance (i'', s''). We call (2) the *hearing constraint*. Constraint (1) says that the agent must (weakly) prefer to take action i over all alternative actions i', *given* that it would do what is intended for it in each circumstance at the hearing. We call Constraint (1) the *primary activity constraint*.

Proposition 6. If i and $(e_1, \ldots, e_s)$ are incentive-compatible with $l(e)$, then we can find (l, e) with $e_{is} = e_s$ for all $s = 1, \ldots, S$, and $l_{i's'} = l(e_{i's'})$ for all (i', s'), such that i and (l, e) satisfy (1) and (2). Conversely, if i and (l, e) satisfy (1) and (2), then we can find a function $l(e)$ with $l_{i's'} = l(e_{i's'})$ for all (i', s') such that i and $(e_{i1}, \ldots, e_{is})$ are incentive-compatible with $l(e)$.

Proof. If $(i; e_1, \ldots, e_S)$ is incentive-compatible with $l(e)$, then set (l, e) as follows: for i and any s set $e_{is} = e_s$ and $l_{is} = l(e_{is}) = l(e_s)$. For all $i' \neq i$ and any s, set $e_{i's}$ to any e minimizing $l(e) + c_{i's}(e)$ and set $l_{i',s} = l(e_{i's})$. Then, for all (i', s'), $l_{i's'} + c_{i's'}(e_{i's'}) = \min_e[l(e) + c_{i's'}(e)]$. From this it follows that i satisfies the hearing and primary activity constraints with the constructed $l(e)$. Conversely, if i and $(l, e) = (l_{11}, \ldots, l_{IS}; e_{11}, \ldots, e_{IS})$ satisfy the direct problem's constraints, construct $l(e)$ as follows: given K, set $l(e) = l_{i's'}$, if $e = e_{i's'}$ and K otherwise. This assignment of l to e is unique since the hearing constraint guarantees that $l_{i's'} = l_{i''s''}$ whenever $e_{i's'} = e_{i''s''}$. If K is large enough, then setting e to a value that does not equal any $e_{i's'}$ is never optimal for the agent at the hearing in any circumstance. Hence, the only relevant alternatives for the

agent in circumstance (i', s') are those assigned to other circumstances. Thus $e_{i's}$ minimizes $l(e) + c_{i's}(e)$ for every i' and s. It is then clear that i satisfies incentive compatibility against $l(e)$. QED

Proof of Proposition 1. Proposition 1 is an immediate consequence of the following more general result.

Lemma 2. Action $i \geq 2$ is implementable, only if for some evidence plan $(e_1, \ldots, e_S)$ the expected evidence costs savings from choosing i over any alternative action i' exceed the additional private costs in the primary activity. Formally, i is implementable, only if

$$\exists (e_1, \ldots, e_s) \in E^S \ s.t. \ \forall i' = 1, \ldots, I, \sum_{s=1}^{S} p_s(c_{i's}(e_s) - c_{is}(e_s)) \geq a_i - a_{i'}. \quad (3)$$

Proof. Consider any alternative action i'. There must be no advantage to the agent from taking action i' and then, in every state, presenting the evidence that she would have presented had she taken action i. Formally, from the primary activity constraint

$$-a_i + \sum_s p_s(-l_{is} - c_{is}(e_{is})) \geq -a_{i'} + \sum_s p_s(-l_{i's} - c_{i's}(e_{i's})). \quad (4)$$

From the hearing constraint, $\forall s = 1, \ldots, S$:

$$-l_{i's} - c_{i's}(e_{i's}) \geq -l_{is} - c_{i's}(e_{is}). \quad (5)$$

Substituting (5) into the right hand side of (4) yields $-a_i + \sum_s p_s(-l_{is} - c_{is}(e_{is})) \geq -a_{i'} + \sum_s p_s(-l_{is} - c_{i's}(e_{is}))$. Canceling the l_{is} terms and rearranging yields (3). QED

Proof of Proposition 2. For notational convenience, reorder actions so that the action to be implemented is now $i = 1$. Consider liability schedules of the following form: $l(e) = 0$, if $e = \hat{e}$, and $l(e) = K$ otherwise. Imagine that the agent presents $e = \hat{e}$ in all circumstances. (We consider hearing incentive compatibility below.) For such single evidence schedules, primary activity incentive compatibility reduces to the system of

$I-1$ inequalities of the form $a_i - a_1 \leq \sum p_s(c_{1s}(\hat{e}) - c_{is}(\hat{e}))$. In matrix form this is

$$\begin{bmatrix} a_2 - a_1 \\ \vdots \\ a_I - a_1 \end{bmatrix} \leq \begin{bmatrix} p_1, \ldots, p_S & -p_1, \ldots, -p_S & 0 & \cdots & 0 \\ p_1, \ldots, p_S & 0 & -p_1, \ldots, -p_S & \cdots & \vdots \\ \vdots & \vdots & 0 & \cdots & \vdots \\ p_1, \ldots, p_S & 0 & \cdots & \cdots & -p_1, \ldots, -p_S \end{bmatrix} \begin{bmatrix} c_{11}(\hat{e}) \\ \vdots \\ c_{IS}(\hat{e}) \end{bmatrix}.$$

By inspection, this matrix of probabilities has $I-1$ linearly independent rows. Also, the right-hand side is invariant to translation of the vector $\{c_{is}(\hat{e})\}_{is}$. Thus, if $\{c_{is}(\hat{e})\}_{is}$, viewed as a function of $\hat{e}$, is onto $\mathbb{R}_+^{I \times S}$, the system has a nonnegative solution in $\hat{e}$. To satisfy hearing incentive compatibility, we need only set K larger than $\max_{is} c_{is}(\hat{e})$.

Proof of Proposition 3. Suppose, on the contrary, that $c_{i's'}(e_{is}) - c_{is}(e_{is}) > (a_i - a_1)/p_s$, for all $(i', s') \neq (i, s)$. By divisibility there exists some other e' that has strictly lower costs for (i, s) $(c_{is}(e') < c_{is}(e_{is}))$ and still satisfies $c_{i's'}(e') - c_{is}(e') > (a_i - a_1)/p_s, \forall (i', s') \neq (i, s)$. I will show that we can implement i with a liability schedule whose costs are strictly lower than those of (l, e). Set $e_{i's'} = 0 \in E$ and $l_{i's'} = -F \in \mathbb{R}$ for all $(i's') \neq (i, s)$ (including outcomes with the same action but different states, and vice versa). Set $e_{is} = e'$ and $l_{is} = -\min_{i's' \neq is} c_{i's'}(e')$. Note that the cost of this schedule is less than for (l, e): $p_s c_{is}(e') + (1 - p_s)F < p_s c_{is}(e_{is}) + (1 - p_s)F \leq \sum_{s'} p_{s'} c_{is'}(e_{is'})$. Secondly, I claim that the schedule is incentive-compatible at the hearing. Because all circumstances besides (i, s) present the same evidence, we need to check only (i, s) vis a vis its alternatives (i', s'). Hearing payoffs for truthful (i, s) are nonnegative: $-l_{is} - c_{is}(e') = \min_{i's' \neq is} c_{i's'}(e') - c_{is}(e') > (a_i - a_1)/p_s \geq 0$. Since pretending to be any (i', s') yields (i, s) payoffs of $-(-F) - c_{is}(0) = 0$, (i, s) has no incentive to lie. Conversely, pretending to be (i, s) leaves an alternative outcome (i', s') with payoffs $-l_{is} - c_{i's'}(e') = \min_{i''s'' \neq is} c_{i''s''}(e') - c_{i's'}(e') \leq 0$, while truthtelling yields payoffs of $-(-F) - c_{i's'}(0) = 0$. I complete the proof by showing

that (l, e) is incentive-compatible in the primary activity. For any i',

$$\begin{aligned}
&-a_i + \sum_{s'} p_{s'}(-l_{is'} - c_{is'}(e_{is'})) \\
&\quad = -a_i + p_s\Big(\min_{i's' \neq is} c_{i's'}(e') - c_{is}(e')\Big) \\
&\quad \geq -a_i + p_s\left(\frac{a_i - a_1}{p_s}\right) = -a_i + a_i - a_1 \geq -a_{i'} + 0 \\
&\quad = -a_{i'} + \sum_{s'} p_{s'}(-l_{i's'} - c_{i's'}(e_{i's'})).
\end{aligned}$$

Proof of Lemma 1. Suppose that i^{FB} is first best. Consider any lower level $2 \leq i' < i^{FB}$ of care. We will show that i' cannot be second best. Since i^{FB} is first best implementable, the sum of precaution and accident costs is lower at i^{FB} than at i': $-a_{i^{FB}} - h_{i^{FB}} \geq -a_{i'} - h_{i'}$. Since C_i is downward sloping, implementation costs are strictly lower at i^{FB}. Thus i^{FB} has strictly lower *total* costs than i', so i' cannot be second best.

Proof of Proposition 5. Immediate from the proof of Lemma 2. QED

Example: [strictly negative change-in-case effect]. We have three actions 1, 2, and 3, with private costs 0, 4, and 10, respectively. Further, we have two pieces of evidence. The first piece of evidence $\underline{e}$ costs \$20, \$10, and \$0 for actions 1, 2, and 3, respectively. The second piece of evidence $\bar{e}$ is more expensive for all actions, costing \$25, \$20, and \$15 for actions 1, 2, and 3, respectively. Note that each piece of evidence is less expensive for actions with higher private costs. Thus evidence costs are ordered "normally." (However, evidence costs do not satisfy a single crossing property.)

Now, action 3 can be implemented with the lowest cost evidence $\underline{e}$: if the agent must present $\underline{e}$ in order to avoid some large amount of liability, then action 3's total payoffs of $-10 - 0 = -10$ are larger than both action 1's, $-0 - 20 = -20$, and action 2's, $-4 - 10 = -14$. Hence, the minimal-cost implementation of action 3 requires that action 3 present evidence $\underline{e}$. Action 2, however, *cannot* be implemented with the lower-cost evidence $\underline{e}$. For suppose that we were implementing action 2 with a liability schedule in which action 2 presents $\underline{e}$. Then action 3 can always present $\underline{e}$ also. This

will give action 3 the same liability as action 2 with \$10 less in evidence costs. Thus action 3's hearing payoffs, from whatever evidence action 3 is called on to produce, must be at least \$10 more than those of action 2. Since its private costs are only \$6 more, action 2 is not implemented. On the other hand, action 2 *is* implemented if all actions present the more expensive evidence $\bar{e}$. Then action 2's total payoffs are $-4 - 20 = -24$, which exceeds both action 1's payoffs, $-0 - 25 = -25$, and action 3's payoffs, $-10 - 15 = -25$. Thus the minimal-cost implementation of action 2 requires that action 2 present evidence $\bar{e}$. Thus the evidence $\bar{e}$ used to implement action 2 at minimal cost is more costly (for all actions, specifically for action 2) than the evidence $\underline{e}$ used to implement action 3 at minimal cost. We conclude that the change-in-case effect in moving from action 2 to action 3 is strictly negative.

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