Reputation and Litigation: Using Formal Sanctions to Control Informal Sanctions[*]

Scott Baker
Washington University in St. Louis Law School

Albert Choi
University of Virginia Law School

February 17, 2013

Abstract

An infinitely-lived firm sells a product to a sequence of short-term consumers, where the quality of the product imperfectly depends on unobservable effort exerted by the firm in each period. The firm can solve the moral hazard problem by relying on either formal or informal sanctions. By promising to pay damages, the firm induces consumers to sue the firm when product quality is low. Lawsuits also generate information that future consumers can use to unleash informal sanctions, where the nature of the information depends on the liability regime chosen by the firm (no-fault versus fault-based damages). The firm makes a trade-off between litigation costs of formal sanctions and inefficient failures to trade under informal sanctions. The model demonstrates that even when the firm can solve the moral hazard problem with formal (informal) sanctions alone, the firm may deliberately rely on both types of sanctions. The paper also compares no-fault and fault-based liability regimes (negligence versus strict liability) and extends the analysis to settings where the remedy is chosen by law.

1   Introduction

For a long time, legal and economic scholars have studied the relationship between formal and informal sanctions (Klein and Leffler 1981; Milgrom et. al. 1990; Ellickson 1991; Bernstein 1992; Richman 2004). Informal sanctions consist of refusals to deal in the future, while formal sanctions involve a remedy dispensed through a dispute resolution mechanism. In theory, both formal or informal sanctions can induce the players to "behave," for instance, to provide high quality goods or services or to "cooperate" with each other. If

---

[*]Preliminary and Incomplete. Please do not cite, quote, or circulate without permission. Comments are, however, welcome to sbaker@wulaw.wustl.edu and ahc4p@virginia.edu.

either sanctions worked perfectly, with full accuracy and at zero cost, we would have an indeterminacy result: it wouldn't matter how private parties choose to solve the incentive problem. In real life, of course, neither sanctions are costless or precise. Formal sanctions often involve costly litigation. Informal sanctions may require the players to sacrifice otherwise beneficial trading opportunities. When neither sanctions are perfect, how one crafts the mixture of the two to solve the incentive problem remains an open issue.

We examine this issue using repeated game theoretic analysis. Our model consists of an infinitely-lived firm facing a sequence of short-term (single-period) consumers. Firm effort (or care) imperfectly translates into product (or service) quality. We assume that it is efficient for the firm to exert a high level of effort: the increased chance of high quality from high effort outweighs its higher cost. Yet, because consumers do not observe the firm's current or past behavior, the firm must rely on an enforcement mechanism to commit to exerting high effort. Commitment can be achieved one of two ways: (1) by promising to pay damages when realized quality is low (formal sanctions) or (2) by informing future consumers of the bad outcomes in the past, thereby enabling them to boycott the firm as punishment (informal sanctions). We assume that neither are perfect: formal sanctions entail cost of dispute resolution. Informal sanctions generate inefficiency because future consumers may wrongfully punish the firm if they rely on information that turns out to be false.

One important theme of the paper is that formal and informal sanctions often work together, as complements. For future consumers to coordinate their punishment strategy, they need to receive some signal about the firm's past behavior. By generating lawsuits, formal sanctions provide that signal (Milgrom et. al. 1990). In that sense, formal sanctions do not necessarily crowd out informal sanctions (Bohnet et. al. 2001; Deci et. al. 1999). Rather, formal sanctions form the informational basis for unleashing informal sanctions. We also show that the firm determines the informational value of litigation through the liability regime it selects. If the firm promises to pay damages whenever quality is low, regardless of the firm's behavior (no-fault or strict liability regime), information generated to the market will be more limited. On the other hand, if the firm makes damages payment conditional on fault (fault-based or negligence regime), court's judgment may produce more accurate information. Despite the informational advantage, the fault-based system does not always dominate the no-fault system. It depends heavily on the correlation between effort and output and the accuracy of court judgment. The more certain the firm is that high effort will lead to high quality or the less certain that the court will render the correct judgment under negligence, the more attractive the no-fault system becomes.

Formal and informal sanctions also work as substitutes. If the firm can rely more on formal sanctions, it needs less informal sanctions, and vice versa. Our firm will seek the optimal mix between the two types of sanctions. If litigation were costless (and if there's no upper limit on the size of liquidated damages), the firm can solve its incentive problem by simply promising to pay high damages. Although the high damages award will make

2

the firm worse off in litigation, the firm can neutralize this effect by charging higher prices up front. Matters change when litigation is costly. Unlike damages, litigation costs cannot be netted out: they reduce the gains from trade. Raising damages to solve the incentive problem thus becomes costly. In that case, the firm might want to decrease the damages so as to preclude certain consumers (those with high litigation cost) from bringing suit. At the same time, the firm can make up for the shortfall in deterrence through informal sanctions.

Relying only on informal sanctions, even if the consumers can costlessly observe the quality of the product in previous periods, may not be optimal either. The downside of informal sanctions is the foregone trade that the parties (the firm and the future consumers) must suffer during the punishment period. Without any formal sanctions, the length of such punishment period may need to be quite high, thereby engendering a large amount of inefficiency. If the firm were to promise to pay damages to consumers for low quality, the firm can (substantially) reduce the number of punishment period necessary to solve the incentive problem. Since the firm would, instead, be bearing the litigation cost (through lower product price), this trade-off will make more sense when the expected litigation cost is low. In this case, the firm deliberately "crowds out" the informal sanctions with formal sanctions.

The model is developed in the context of contracts, where the firm is selecting both the liability regime and remedy (damages). The results easily translate to other areas of the law with mandatory rules, such as products liability and criminal penalties. The best mandatory legal regime creates deterrence at the lowest combined cost of formal and informal sanctions. In constructing tort policy, for instance, the social planner steps into the shoes of the firm in our model. She might wish to cap formal damages to limit litigation costs, deploying informal sanctions to make up for the gap in deterrence (Polinsky and Shavell 2010). But she must pay attention to the subtle interactions between the legal regime and the inferences future consumers make from litigation. Our model thus shows that the choice between negligence and strict liability differ in ways not captured by the classic tort models. It is about more than creating appropriate activity-level choices and the relative administrative costs of the two systems (Shavell 1980). A comparison of the two regimes must also consider the information litigation under different regimes releases to future consumers.

Before proceeding, one caveat is in order: litigation here forms the signal upon which reputational penalties are assessed. Consumers, of course, have access to other sources to find out about product quality: the internet, Consumer Report, Angie's list, etc. If these signals worked perfectly, litigation, or even ex ante regulation, would be unnecessary. With a sufficiently patient firm, informal sanctions, that depend on the *perfect* information from these sources, will solve the moral hazard problem without any inefficiency. Our idea is that, given that no source of information is perfect, litigation-outcomes function as one informative signal of the underlying behavior of the firm. It does so by partially validating

the plaintiff's claim. For instance, a lawyer must think the plaintiff has a case, and such gate-keeping limits the ability of consumers to sue where quality turned out to be as high as the firm promised. And, a better signal leads to more efficient reputational sanctions. That said, we do not deny these other sources of information play an important role. We view this paper as a first step, analyzing the case where consumers base beliefs, at least in part, on lawsuits.

The paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the basic setup of the model and section 4 lays out some benchmark results: formal sanctions when litigation is costless and informal sanctions when consumers perfectly observe the firm's past and current behavior. The benchmarks highlight the importance of thinking about the costs associated with either deterrence regime. Section 5 presents the main results. We first examine no-fault and fault-based regimes separately and then compare. Specifically, we examine how the different public information generated through different liability regimes influence the nature of the informal sanctions. We also show the conditions under which the firm may decide to rely only on formal sanctions and under which the firm may rely on informal sanctions even if relying only on formal sanctions is feasible. Comparison also reveals some subtle but important notes about the relative advantages and disadvantages of the two regimes. In section 6, extensions of the basic model are discussed, including the presence of other sources of information and secret settlements. The last section concludes. The appendix contains the proofs.

2   Related Literature

The economic literature on reputation is extensive. Klein and Leffler (1981) and Shapiro (1983) recognized that reputation should be viewed as a firm asset. If a firm provides low quality, it forfeits its reputational capital: the discounted stream of income associated with the ability to price above marginal cost in the future. The basic insight is that price must be above marginal cost—there must be something to forfeit—in order for reputational sanctions to work. Their models rely on a strong assumption that future consumers perfectly observe the quality provided in the prior periods. More recent research has relaxed this assumption of perfect observability. Cripps et. al. (2003), for example, analyzes a game of imperfect public monitoring, where public signals observed by consumers do not perfectly reveal the strategies played by a long-lived firm. They show that imperfect public monitoring means that firms cannot, in equilibrium, sustain a permanent reputation. Although our paper is similar in spirit, our focus is more on how such public information gets generated through litigation and how firms can affect the information generation process through contract design.

Our paper also relates to the literature on relational contracts (Scott 1987; MacLeod and Malcomson 1989; MacLeod 2007). Typically, two long-run players are matched against each other and some aspects of their relationship are assumed to be not verifiable by court.

Cooperative outcome in such a relational contract is then supported by threats to either discontinue the relationship or revert to a stage-game Nash equilibrium. The main issue examined are the conditions under which a cooperative outcome can be obtained and how the contract can be designed to achieve that outcome. With the setup of two long-run players, on the other hand, the issues of observability and knowledge of history are implicitly assumed away. Furthermore, what can or cannot be verified is exogenously determined. In our model, by contrast, a long-run player influences what future players observe by subjecting itself to litigation and also by affecting the content of the information generated through litigation.

The literature that examines the interaction between formal and informal sanctions is not extensive. Milgrom, et. al. (1990) examines the Law Merchant system relied on by traders in medieval Europe. Similar to our paper, they show how adjudication by a law merchant judge can faciliate cooperation among traders by providing information about whether or not a certain trader has cheated in the past. The paper, however, does not examine the informational content of the adjudication nor how the informal sanctions interact with fines imposed through court. Cooter and Porat (2001) argue that the court-imposed damages should take nonlegal sanctions into account. The paper, however, does not examine how nonlegal sanctions respond to legal sanctions nor how dispute resolution mechanism can be designed while accounting for that interaction.

Two more recent papers examine the interaction between formal and informal sanctions. Gilson et. al. (2010) considers a firm's choice whether and how to "braid" formal and informal sanctions. As with the relational contract literature, the situation considered involves two long run players. In their framework, low-powered formal sanctions—for instance, a penalty for a failure to provide research results in a joint venture—help contracting parties learn about each other, and this learning allows for a more effective use of informal sanctions. The paper differs from this paper by focusing on learning between two long-run players. Ganuza et. al. (2012) examines the interaction between formal and informal sanctions in a products liability context. In a repeated game context, the paper demonstrates that greater formal sanctions can enhance the efficiency of the informal sanction. The paper does not, however, consider the cost of litigation. In addition, formal sanctions are exogenously capped. Both assumptions limit the ability to compare the costs and benefits of informal and formal sanctions.

3 The Setup

An infinitely-lived firm faces a sequence of single-term consumers in periods $t \in \{1, 2, 3, ...\}$.[1]
The firm has a discount factor of $\delta \in (0, 1)$. In each period, the firm offers each consumer
a contract for the purchase of a single product (or service). Denote the contract offer by
$\kappa = (p, d, r)$, where p stands for price, $d \geq 0$ for liquidated damages, and r for the fault (or
liability) regime. For the sake of simplicity, we do not use a time subscript. After observing
the contract offer, the consumer decides to either accept or reject. If the consumer rejects
the offer, both parties get a payoff of zero for that period. If the consumer accepts the
offer, the firm chooses the level of unobservable effort $e \in \{e_h, e_l\}$ and the consumer pays
the price p. The cost of effort is given by $c(e_i) = c_i$ where $c_h > c_l \geq 0$. Product quality
can be either high or low: $q \in \{q_h, q_l\}$. Effort choice does not perfectly translate to product
quality: $prob(q_h|e_l) = \pi$ and $prob(q_h|e_h) = 1 - \pi$, where $\pi \in (0, 1/2)$.

Each consumer values high quality at v_h and low quality at v_l, where $v_h > v_l \geq 0$. We
assume that (1) putting in high effort is more efficient than putting in low effort ($E(v|e_h) -$
$c_h > E(v|e_l) - c_l$); (2) high quality generates a strictly positive surplus ($v_h > c_h$); and (3)
low quality generates a strictly negative surplus ($v_l < c_l$). We will also assume that π is
sufficiently low so that $E(v|e_h) - c_h > 0$ but remain agnostic on $sign(E(v|e_l) - c_l)$. The
following table represents the stage game payoffs without formal sanctions.

	High Effort	Low Effort
Not Purchase	$(0, 0)$	$(0, 0)$
Purchase	$(E(v|e_h) - p, p - c_h)$	$(E(v|e_l) - p, p - c_l)$

Table 1: Stage Game Payoffs without Formal Sanctions ($d = 0$)

After the consumer receives the product, she learns its true quality. If the quality
is low, the consumer can bring a lawsuit. The lawsuit allows the consumer to recover
liquidated damages of d. The consumer realizes the cost of bringing a lawsuit after he
purchases the product. Litigation costs are given by $k \in \{k_l, k_h\}$, where $k_h > k_l \geq 0$ and
$prob(k = k_l) = \theta \in (0, 1)$.[2] The success of a lawsuit depends on the liability regime (r)
stipulated in the contract. If the firm selects a no-fault (strict liability) regime ($r = s$),
it must pay damages whenever the consumer receives low quality regardless of the firm's

---

[1]Our model is a variation on the classic models by Klein and Leffler (1981) and Shapiro (1983). Two
important sources of departure are (1) that the litigation generates information for future consumers to coor-
dinate their informal sanctions on; and (2) the firm can rely on litigation (with different liability standards)
to affect the information-production process and also as (partial) deterrence.

[2]We have adopted two discrete levels of litigation cost, $k \in \{k_l, k_h\}$, for consumers and zero litigation
cost for the firm for ease of exposition. We can, instead, allow a consumer's litigation cost to come from a
continuous distribution, $k \in [k_l, k_h]$, and the firm to bear positive litigation cost ($k_f > 0$), but the qualitative
results, we suspect, will not change. We plan to extend the analysis to incorporate continuous distribution
of litigation cost.

actual effort choice. If the firm selects a fault-based (negligence) regime ($r = n$), the firm must pay damages when both the product quality is low and the court finds that the firm has put in low effort. We assume that although the court does not make any error in determining the realized quality, the court can err in determining effort. Specifically, even if the firm has chosen high effort (low effort), the court can rule against the firm (in favor of the firm) with probability $\sigma \in (0, 1/2)$: σ thus represents both type-1 and type-2 errors made by court. Combining all the parameters yields the conditions necessary for the consumer to bring a lawsuit. For instance, after receiving low quality, under the no-fault regime, the consumer will sue only if $d \geq k_i$. Under the fault-based regime, she will sue only if $\sigma d \geq k_i$ if she (rationally) believes that the firm put in high effort.

In addition to the formal sanctions, consumers can impose informal sanctions by not purchasing from the firm for $T \geq 0$ periods. The liability regime determines the severity of the sanctions (the size of T) and how they are triggered. We are particularly interested in the informational role played by litigation. Given this interest, we initially assume that without any court judgment, the consumer in period t does not observe any of the outcomes in previous periods, e.g., whether or not the product quality was low or the firm exerted low effort. In contrast, we assume that the court's judgment in period t is observed by all consumers in period $t' \geq t$. Given that the court's judgment is public information, future consumers can coordinate on that information. Under a no-fault regime, for instance, if the court in period t finds that the product sold is of low quality, future consumers, from period $t + 1$ on, can punish the firm by not purchasing from the firm for T periods. Likewise, under a fault-based regime, future consumers can refrain from purchasing from the firm for T periods when the court finds that low quality resulted from low firm effort.

4   Benchmarks

Suppose there are no formal sanctions ($d = 0$) and the consumers do not observe the past outcomes. Because the consumer in period t does not observe the level of effort chosen by the firm nor the history, the unique equilibrium is for the firm to choose low effort every period. From Table 1, conditional on purchase, the firm strictly prefers to exert low effort. Rationally expecting that the firm will choose low effort, the consumers will be willing to pay only up to $E(v|e_l) = \pi v_h + (1 - \pi)v_l$, which also is the maximum price the firm can charge the consumer. If π is sufficiently large, the assumption of $v_l < c_l$ implies that there may be insufficient surplus: $E(v|e_l) < c_l$. In that case, the firm will not serve the market. If π is small, the firm will serve the market provide low quality and charge low prices. Either way, the equilibrium will be inefficient.

Now suppose that the firm can rely on formal sanctions ($d > 0$). Consider the case of costless litigation ($k_h = k_l = 0$). If there is no upper limit on damages,[3] the firm will be able

---

[3]An upper limit on liquidated damages may stem from the anti-penalty doctrine in contract law. Our formulation replicates the familiar result that such limitations can prevent efficient exchanges.

to costlessly solve the commitment problem by simply raising the damages. Suppose we are in a no-fault regime, under which consumers can collect damages whenever the realized quality is low. The firm's incentive problem will be solved by setting damages to satisfy

$$p - c_h - \pi d \geq p - c_l - (1 - \pi)d \Longrightarrow d \geq \frac{c_h - c_l}{1 - 2\pi}$$

Furthermore, given that the consumer would be willing to pay upto $E(v|e_h) + \pi d$ for the product, the firm will be able to charge $p = E(v|e_h) + \pi d$ and extract all the gains from the trade. The damages term in the contract is "neutralized" through a higher price, and the firm suffers, in expectation, no reduction in profit. The present value of all present and future profits for the firm, with the discount factor of δ, is

$$\frac{E(v|e_h) - c_h}{1 - \delta}$$

The analysis is comparable under a fault-based regime. When formal sanctions are costless, therefore, the firm can achieve the first best. When litigation is costly $(k_i > 0)$, this will no longer be true.

Now suppose there are no formal sanctions $(d = 0)$, but the consumers observe the firm's effort choice in previous periods. If the firm is sufficiently patient, first-best can again be achieved using only informal sanctions. As an example, suppose, upon discovering that the firm put in low effort in period t, all future consumers from period $t + 1$ and on do not purchase from the firm. This is the maximal reputational punishment that the consumers can impose on the firm for its deviation. For the firm to choose high level of effort, given this grim-trigger punishment strategy, we need

$$\frac{p - c_h}{1 - \delta} \geq p - c_l \Longrightarrow E(v|e_h) \geq \frac{c_h - (1 - \delta)c_l}{\delta}$$

where we substituted p with $E(v|e_h) - c_h$. With the assumption that $E(v|e_h) > c_h$, the inequality will be satisfied if the firm is sufficiently patient. We will assume that this is true. Because the consumers observe the firm's behavior in the previous periods without error, in equilibrium, the firm will always put in high effort. Consumers, as a result, will never unleash reputational punishment.

5   Using Both Formal and Informal Sanctions

Let's restore the assumptions that the litigation is costly for the consumer to initiate $(k_h > k_l \geq 0)$ and that the consumers do not observe the firm's (present or past) effort choice. What the consumers observe will depend on the information generated through litigation. The reliability of the information (accuracy of judgment), in turn, depends on the contractually-stipulated liability regime. We analyze the no-fault regime first and compare

the two regimes. Before we proceed, however, we present the following Lemma to faciliate the remainder of the analysis. The Lemma demonstrates that if the firm decides to rely on both formal and informal sanctions, it will set damages relatively low so that only the low cost litigants bring suit in equilibrium.

Lemma 1 *If the firm relies on both formal and informal sanctions to provide necessary incentive, the firm will set damages so that the consumer will sue only when litigation cost is low ($k = k_l$).*

The intuition of Lemma 1 runs like this. Suppose the firm allowed both high cost and low cost litigants to sue when realized quality is low. Since the firm (being able to make a take-it-or-leave-it offer) is the residual claimant, the firm's per-period profit will decrease by the size of the expected litigation costs. When both types of litigants sue, the firm is paying full freight for formal sanctions and it makes sense to achieve deterrence only using formal sanctions. If it layers informal sanctions on top of formal sanctions, the firm incurs the unnecessary additional costs of the reputational punishment. The firm wants to combine formal and informal sanctions only when the combination provides a savings on the litigation costs, for instance, by lowering damages to limit lawsuits to low-cost litigants.

5.1 No-Fault Liability (Strict Liability) Regime

Suppose the firm adopts the no-fault liability regime. The firm may solve the incentive problem using either only the formal sanctions or relying on both formal and informal sanctions. If using only formal sanctions, the best possible scenario is to induce only the low-cost litigants to sue but to set the damages sufficiently high to solve the incentive problem: $d \geq \frac{c_h - c_l}{\theta(1-2\pi)}$. This possibility, however, requires, the high litigation cost to be sufficiently high. If $k_h \leq \frac{c_h - c_l}{\theta(1-2\pi)}$, for instance, choosing $d \geq \frac{c_h - c_l}{\theta(1-2\pi)}$ will also induce high-cost litigants to sue and the firm will be unable to keep the high-cost litigants away while solving the incentive problem. In that case, if there is enough surplus to cover the expected litigation expenses, the firm may allow both types of litigants to sue, achieving deterrence with formal sanctions alone.

Another possibility is to rely on a combination of informal and formal sanctions by limiting damages, i.e., $d < \min\{\frac{c_h - c_l}{\theta(1-2\pi)}, k_h\}$. Per Lemma 1, when the firm relies on both, the firm will induce only low-cost litigants to bring suit. To achieve necessary deterrence, the punishment period must be long enough to make up for the shortfall on the formal sanctions. Formally, combining formal and informal sanctions to achieve deterrence requires that

$$\delta(1 - \delta^T)\frac{E(v|e_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^T)\delta\pi\theta} \geq \frac{c_h - c_l}{\theta(1-2\pi)} - d \tag{1}$$

9

The expression on the right hand side represents the shortfall on formal sanctions. The left hand side of the inequality represents the additional incentive provided through informal sanctions. The inequality simply states that the size of the informal sanctions must be large enough to make up for the shortfall on formal sanctions. The following proposition establishes the conditions under which relying on both formal and informal sanctions is better than relying on formal sanctions alone.

Proposition 1 *Suppose the firm uses no-fault regime ($r = s$). When the expected surplus with litigation cost ($E(v|e_h) - c_h - \pi E(k)$) is relatively small or negative, the firm will rely on both formal and informal sanctions to provide care incentive. More formally,*

1. *Suppose $E(v|e_h) - c_h - \pi E(k) < 0$. If $k_h > \frac{c_h - c_l}{\theta(1-2\pi)}$, the firm will rely only on formal sanctions by setting $d = \frac{c_h - c_l}{\theta(1-2\pi)}$. If $k_h \leq \frac{c_h - c_l}{\theta(1-2\pi)}$, relying only on formal sanctions is not feasible and the firm will rely on both formal and informal sanctions by setting $d = k_h - \varepsilon$ where ε is small but positive.*

2. *Suppose $E(v|e_h) - c_h - \pi E(k) \geq 0$. If $k_h > \frac{c_h - c_l}{\theta(1-2\pi)}$, the firm will rely only on formal sanctions by setting $d = \frac{c_h - c_l}{\theta(1-2\pi)}$. If $k_h \leq \frac{c_h - c_l}{\theta(1-2\pi)}$, the firm will rely on both formal and informal sanctions when $E(v|e_h) - c_h - \pi E(k)$ is sufficiently small.*

The proposition highlights the basic trade-off in the model. If, on the one hand, the firm uses informal sanctions, there is a chance that the consumer will receive low quality even when the firm takes high effort. Because future consumers only observe litigation, not actual firm effort, inefficiency arises out of the subsequent consumer boycott of that firm. The punishment follows even though the firm, in equilibrium, selected the appropriate effort choice.[4] On the other hand, if the firm relies on formal sanctions and, for instance, allows all consumers to sue whenever quality is low, litigation costs reduce the gains from trade. Any reduction in the gains from trade impact the firm's profits. As a result, the decision whether to rely only on formal sanctions or on both formal and informal sanctions depends on the relative size of the two inefficiencies. The size of the inefficiency from relying only on formal sanctions depends on the size of the litigation cost. The size of the inefficiency from informal sanctions depends, among other things, on the length of the punishment period (T).

The proposition shows that when the high litigation cost is quite large ($k_h > \frac{c_h - c_l}{\theta(1-2\pi)}$), the firm would rely only on formal sanctions to solve the incentive problem. The reason is that, when k_h is sufficiently large, the firm can raise damages as much as necessary without

---

[4]In equilibrium, consumers know the firm selected high effort and punish low quality anyway. This difficulty arises in many models of this sort (see Fudenburg & Tirole, p. 187). One way to deal with this issue is to allow the firm to mix between high and low effort, setting the punishment phase just long enough to induce firm indifference. Then, the consumer cannot be sure whether the firm put in low or high effort.

having to worry about lawsuits from high-cost litigants.[5]   If the firm sets $d = \frac{c_h - c_l}{\theta(1 - 2\pi)}$ when $k_h > \frac{c_h - c_l}{\theta(1 - 2\pi)}$, for instance, low quality triggers lawsuit only from low cost litigants. Nonetheless, the damages are large enough to solve the firm's incentive problem. Note also that increasing damages does not hurt the firm's bottom line. The firm can neutralize its effect by raising the price by a fraction πd. The end result is similar to the benchmark case with zero litigation cost. Relying on formal sanctions alone is optimal.

The problem becomes more complicated when the litigation costs for the high cost litigant are not that large. When $k_h \leq \frac{c_h - c_l}{\theta(1 - 2\pi)}$, the firm can no longer rely solely on formal sanctions to solve the incentive problem while allowing only the low-cost litigants to sue. High damages award, e.g., $d = \frac{c_h - c_l}{\theta(1 - 2\pi)}$, will attract lawsuits from both types of litigants. Since the firm absorbs these litigation costs through lower prices up front, this will hurt the firm's bottom line. In the extreme, the expected litigation costs may be so high as to eliminate the gains from trade altogether. When the surplus is thus eliminated or substantially reduced, supplementing formal sanctions with informal sanctions will be optimal.

To see this more clearly, suppose the firm sets the damages close to the value necessary to achieve commitment without attracting the high cost litigant (k_h is smaller than but close to $\frac{c_h - c_l}{\theta(1 - 2\pi)}$). The commitment gap left by the formal sanctions is small and, as a result, the length of any punishment period necessary to make up that gap can be short. A shorter punishment period also decreases the efficiency loss from informal sanctions. Similarly, when high effort rarely leads to the low quality—when π is small—the efficiency loss from informal sanctions will also be small. Informal sanctions misfire infrequently: rarely do consumers receive low quality, sue and trigger a boycott, given that the firm exerts high effort. Fewer mistaken informal punishments, then, make reliance on informal sanctions more desirable.

5.2   Fault-Based Liability (Negligence) Regime

Suppose the firm adopts the fault-based liability regime, so that the consumer can recover damages when both the quality is low and the court finds that the firm put in low effort (the firm was at "fault"). Similar to the case of no-fault regime, if the firm wants to rely only on formal sanctions and allow only the low litigation cost consumers to sue, it needs sufficient damages to commit to high effort: $d \geq \frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]}$. If, on the other hand, the firm wishes to rely on a combination of formal and informal sanctions, the firm needs to satisfy

$$\delta(1 - \delta^T)\frac{E(v|e_h) - c_h - \pi\theta k_l}{(1 - \delta) + \pi\sigma\theta\delta(1 - \delta^T)} \geq \frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]} - d \qquad (2)$$

---

[5] If the litigation cost (k) had a continuous distribution, raising damages will induce more litigants to file suit. When the distribution is spread widely, the increase in probability of litigation from raising damages will fall and the firm will worry less about this cost. We suspect that k_h being large is qualitatively similar to having a low density function when the litigation cost is continuously distributed.

11

The expression is largely similar to that for no-fault regime. The right hand side of the inequality represents the shortfall on formal sanctions. The left hand side of the inequality represents the additional incentive provided through informal sanctions (in terms of present value). To provide sufficient care incentive, therefore, the size of the informal sanctions must be large enough to make up for the shortfall on the formal sanctions.

Proposition 2 *Suppose the firm uses fault-based of negligence regime: $r = n$. When the expected surplus with litigation cost $(E(v|e_h) - c_h - \pi E(k))$ is relatively small or negative, the firm will rely on both formal and informal sanctions to provide care incentive. More formally,*

1. *Suppose $E(v|e_h) - c_h - \pi E(k) < 0$. If $k_h > \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$, the firm will rely only on formal sanctions by setting $d = \frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$. If $k_h \leq \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$, relying only on formal sanctions is not feasible and the firm will rely on both formal and informal sanctions by setting $d = \frac{k_h}{\sigma} - \varepsilon$ where where $\varepsilon \approx 0$ but positive.*

2. *Suppose $E(v|e_h) - c_h - \pi E(k) \geq 0$. If $k_h > \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$, the firm will rely only on formal sanctions by setting $d = \frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$. If $k_h \leq \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$, the firm will rely on both formal and informal sanctions when $E(v|e_h) - c_h - \pi E(k)$ is sufficiently small.*

The basic intuition behind the proposition is the same as that for the no-fault regime. There is trade-off between using formal and informal sanctions. Formal sanctions entail litigation costs. Informal sanctions lead to periods of faulty punishment. Similar to the no-fault regime, if the high cost litigant faces substantial costs, formal damages can be set high enough to achieve commitment power, while only inducing suits by low-cost litigants. Given the commitment power flows entirely from the formal sanctions, there is no need for inefficient reputational punishment. Formally, the condition on the cost of the high cost litigant is $k_h > \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$.

If this condition does not hold, the firm may want to rely on both formal and informal sanctions. Informal sanctions are most attractive when the gains from trade fail to cover the litigation expenses in the event both the high and low-cost litigant sue. Yet, even if it is possible to solve the incentive problem with formal sanctions without the market collapsing, the firm may deliberately choose to rely on informal sanctions. It does so when the loss from reputational punishment is relatively small (for example, when π is small and/or k_h is smaller than but close to $\frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$).

5.3 Liability Regime Comparison

Although the main logic behind relying on informal sanctions is the same for both no-fault and fault-based regimes, there are some critical differences. Recall that under the no-fault regime, for the combination of formal and informal sanctions to work effectively, the reputational punishment must be long enough to satisfy

$$\delta(1 - \delta^T)\frac{E(v|e_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta} \geq \frac{c_h - c_l}{\theta(1 - 2\pi)} - d$$

The comparable condition under the fault regime is

$$\delta(1 - \delta^T)\frac{E(v|e_h) - c_h - \pi\theta k_l}{(1 - \delta) + \pi\sigma\theta\delta(1 - \delta^T)} \geq \frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]} - d$$

Two important differences stem from how informal sanctions get triggered under either regime and the accuracy of the court's fault finding.

The first important difference is the discounted profit associated with exerting high effort. With the fault-based regime, this profit is $\frac{E(v|e_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta\sigma}$. With the no-fault regime, this profit is $\frac{E(v|e_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta}$. Due to the presence of σ in the denominator, the discounted profit associated with a fault based regime is always larger, holding everything else equal. The reason is that under the fault-based regime, the firm is less likely to trigger the punishment phase when it exerts high effort. Punishment arises only when a consumer sues following over low quality and the court finds fault. Under the no-fault regime, punishment follows when a consumer sues over low quality, a higher probability event. The decreased chance reputational punishments will misfire means that, under a fault regime, the firm reaps a higher discounted profit from exerting high effort.

Second, under the fault-based regime, the threshold necessary to achieve complete deterrence deploying only formal sanctions is $\frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]}$. Under the no-fault regime, that threshold is $\frac{c_h - c_l}{\theta(1 - 2\pi)}$. Notice that that $\frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]} > \frac{c_h - c_l}{\theta(1 - 2\pi)}$ whenever $\sigma > \pi$ and vice versa. In other words, the minimum sanctions necessary to achieve deterrence will be higher under fault-based regime when the court's judgment is a worse signal of effort than the realized quality. An uninformative court judgment has the effect of letting the liable firm off the hook and undermining deterrence. Take the extreme case where $\sigma = \frac{1}{2}$. Because the court's judgment lets the shirking firm escape liability with 50% probability, to solve the deterrence problem with formal sanctions, the damages must be twice as large: $\frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]} = 2\frac{c_h - c_l}{\theta(1 - 2\pi)}$ when $\sigma = \frac{1}{2}$. The following proposition formalizes how these differences influence the choice between fault and no-fault regimes.

Proposition 3 *Suppose that k_h is the in range of values where firm prefers to use a combination of formal and informal sanctions under either regime. For π small but positive,*

the firm strictly prefers the no-fault regime as σ approaches $\frac{1}{2}$. The firm strictly prefers fault-based regime as σ approaches zero.

If the court's determination of fault is unreliable ($\sigma \approx \frac{1}{2}$), it becomes more difficult to solve the incentive problem using just damages in a fault-based regime. For instance, when $\sigma = \frac{1}{2}$, with the optimal damages set by the firm (k_h under no-fault regime and $\frac{k_h}{\sigma}$ under fault-based regime), the damages shortfall under the fault-based regime is twice as large as that under the no-fault regime: $\left(\frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]} - \frac{k_h}{\sigma} \right) = 2 \left(\frac{c_h - c_l}{\theta(1-2\pi)} - k_h \right)$. The larger the shortfall, the bigger the informal sanctions necessary to make up for the shortfall (T is larger). And longer periods of informal sanctions lead to larger efficiency losses.

An unreliable judiciary alone, however, does not make the no-fault regime dominate the fault-based regime. Even with $\sigma = \frac{1}{2}$, the inefficiency from faulty reputational punishment is still smaller under the fault-based regime than under the no-fault regime. That is, if the firm exerts high care but the consumer receives low quality, fault-based regime still allows the firm to escape the reputational punishment a higher percentage of the time. From the left hand side of the incentive conditions, this effect is captured by the smaller discount rate: $(1 - \delta) + \pi\sigma\theta\delta(1 - \delta^T)$ versus $(1 - \delta) + (1 - \delta^T)\delta\pi\theta$. This relative advantage of the fault-based system, however, shrinks as π gets smaller. Combining the two, the no-fault regime performs better than the fault-based regime when π is relatively small and σ is relatively large.[6]

It is not surprising that a no-fault regime functions better than a fault-based regime when the fault-based regime is prone to error. Intuitively, it also makes sense that no-fault systems work better as the technology linking effort and output sharpens. The following result, however, is surprising: legal error in and of itself doesn't necessarily move us away fault-based systems. Despite being subject to error, fault-based system always have the desirable effect of limiting the amount of inefficient reputational punishment. In applying a fault regime, a completely error prone court will issue a liability finding only half as much as a court applying a no-fault regime.

Finally, as the court's determination becomes more accurate (as σ gets smaller), the fault-based regime dominates the no-fault regime. The effects are coming from the both sides of the ledger. Even if the quality outcome from the firm's care choice is uncertain ($\pi > 0$), accuracy in court's determination will cancel out such a noise so that the inefficiency from faulty reputational punishment will disappear. From the left hand side of the incentive condition for the fault-based regime, $(1 - \delta) + \pi\sigma\theta\delta(1 - \delta^T) \longrightarrow (1 - \delta)$ as $\sigma \longrightarrow 0$. Furthermore, as the court becomes more accurate in its fault determination, any damages

---

[6] When court's determination is unreliable ($\sigma \approx 1/2$), even though fault-based (negligence) regime has been chosen by the firm (or by law), consumers may decide to trigger informal sanctions upon learning that a lawsuit has been filed against the firm rather than waiting for the court judgment. If the consumers can do that, fault-based regime will always (at least weakly) dominate the no-fault regime.

based on the court's judgment becomes a more effective device to solving the incentive problem. This also reduces any shortfall in formal sanctions ($\frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]} - \frac{k_h}{\sigma}$ decreases as σ goes down). Hence, regardless of π, the more accurate court judgment will make fault-based regime dominate the no-fault regime.

6 Extensions

We have emphasized the role of litigation in generating information for future contracting parties. In real life, of course, contracting parties may also have access to many other sources of information, such as mass media, Consumer Reports, online consumer reviews, and even government-produced studies. Other sources of information may substitute or complement information from litigation. At one extreme, consumers may want to engage in informal sanctions regardless of formal judgment from litigation. On the other, consumers may wait to aggregate information from both litigation and other sources to impose a more accurate, tailored informal sanctions. The model can be easily extended to allow for other sources of information, for instance, by introducing another public signal for the consumers. To the extent that litigation allows a more formalized process of discovery, however, one suspects that litigation can potentially produce more accurate, reliable information for the consumers. This also seems to be supported by various empirical studies (Alexander 1999; Karpoff et. al. 1999).

The following corollary demonstrates that even if the consumers can costlessly observe the quality of the product sold by the firm in prior periods, the firm may still want to rely on both formal and informal sanctions to solve the incentive problem. The downside of informal sanctions, as noted before, is the foregone trade that the parties suffer when the information that the consumers rely on turn out to be false. If the firm were to rely only on informal sanctions, the length of the punishment (foregone trade) period may need to be substantially long to provide the requisite incentive to the firm. If the firm were to promise to pay damages when quality is low, the punishment period necessary can be shortened: the firm will deliberately "crowd out" informal sanctions. Instead, the firm will bear the cost of litigation. Intuitively, when the cost of litigation is relatively small and/or when the false positives are less likely (which reduces the expected litigation cost), relying on both types of sanctions will dominate.

Corollary 1 *Suppose all consumers observe the quality of the product in previous periods, so that they can engage in informal sanctions against the firm even if there is no litigation. Even though the firm can solve the incentive problem with informal sanctions alone, when π or k_l are sufficiently low, the firm will rely on both formal and informal sanctions.*

From the model, once a lawsuit has been filed by a consumer (or when a consumer threatens to file a lawsuit), knowing that an adverse judgment will lead to an informal

15

sanctions by future consumers, the firm may have a strong (short-term) incentive to secretly settle with the consumer so as to deprive the future consumers of the necessary information to engage in informal sanctions. There are two problems with such secret settlements. First, even if all (threatened) lawsuits are secretly settled, once consumers rationally expect this, equilibrium will revert back to the Nash equilibrium of the stage game, where no trade takes place in all periods. To prevent this unraveling, the firm may have a long-term incentive to commit to a more public release of information. Perhaps this can explain why firms often allow consumers to bring lawsuits in court rather than through informal arbitration, even though arbitration is perceived to be (much) less costly. Second, perhaps more importantly, even if the firm were to attempt to secretly settle with consumers, the fact that the consumers are privately informed of their litigation costs will most likely prevent all lawsuits from settling. The presence of asymmetric information actually helps both the firm and the consumers in achieving a more efficient equilibrium.[7]

The model has also shied away from analyzing the private incentives of consumers to engage in informal sanctions against the firm once the firm has been found liable. When a reputational sanction is to kick in, both the firm and consumers will have an incentive to "renegotiate" away from the informal sanctions, so that the consumers will keep purchasing from the firm with the firm's promise of exerting high effort. Setting aside the issue of whether this will lead to an equilibrium unraveling, there are (at least) two ways of dealing with this issue. First is by shifting the identity of the offeror in the punishment phase. Rather than not purchasing from the firm, we can allow the consumers to make offers ($p = c_h$) and purchase from the firm, with the firm exerting high effort, during the punishment period with the firm exerting high effort (Cai and Obara 2009).[8] Another is by introducing a competitive structure in the relevant market. We can imagine a competing, long-lived firm that produces a substitute product and allow the consumers to purchase at random between the two firms during the cooperation phase and purchase from only one firm during the punishment phase. Either method will eliminate the renegotiation surplus.

7 Conclusion

While legal and economic scholars have long recognized that either legal or reputational sanctions deters bad behavior, not many have closely examined the interaction between the two types of sanctions. This paper has argued that two sanctions can often be mutually re-enforcing: formal sanctions can provide the informational basis upon which informal

---

[7]When the firm sets the damages to induce only the k_l consumers to bring suit, k_h consumers will have a negative value (nuisance) suit. If the firm were to settle with all consumers, even the k_h consumers will threaten to sue. The firm, in turn, would not want to settle with all consumers. In equilibrium, not all lawsuits (or threats) will be settled. See Nalebuff (1987) for a similar analysis.

[8]Not that this renegotiation-proof "solution" requires the players to play a different game in the punishment stage. This raises another issue of how the players can switch from one game form to another: firm offer versus consumer offer game.

sanctions can unleash. Neither form of sanctions is perfect, however. Formal sanctions impose cost of litigation (dispute resolution) while informal sanctions can lead or force parties to forego beneficial trade. Optimal deterrence system, therefore, should make a trade-off between those two costs. The paper has shown that how that balance is achieved will depend on the liability regime chosen (strict liability versus negligence); and in achieving that balance, private parties may opt for a mixture of the two even when relying exclusively on formal or informal sanctions is feasible. Finally, while the primary focus of the paper as been on the design of the optimal deterrence system by private parties, the paper argues for the consideration of these issues when the liability regime is implemented through law, as in tort or criminal sanctions.

Appendix: Proofs (Incomplete)

Proof of Lemma 1. Let's start with the no-fault (strict liability) regime. Suppose the firm uses both types of sanctions but allow only the low-cost litigants bring suit when quality is low ($d \in [k_l, k_h)$). Suppose, in equilibrium, the firm charges $p = E(v|c_h) + \pi\theta(d - k_l)$ and exerts high care. The consumers coordinate on the following strategy. At $t = 1$, consumer purchases the product (service) at p. If, at any $\hat{t} \geq 1$, a consumer receives low quality and the litigation cost is low, the consumer $\hat{t}$ sues the firm and receives d. Furthermore, for the following $T \geq 1$ periods, starting from $\hat{t} + 1$ until $\hat{t} + T$, consumers do not purchase the product from the firm. After the punishment phase, consumer in period $\hat{t} + T + 1$ cooperates again by purchasing the product. The firm's discounted stream of payoffs from high care can be represented recursively as

$$V_s^+ = p - c_h - \pi\theta d + \delta(1 - \pi\theta)V_s^+ + \delta\pi\theta V_s^-$$

The stream of payments in the punishment phase (which lasts T periods) is $V_s^- = \delta^T V_s^+$. The firm's payoff from providing low care (deviation) is

$$p - c_l - (1 - \pi)\theta d + \delta(1 - \pi)\theta V_s^- + \delta(1 - (1 - \pi)\theta)V_s^+$$

The firm will put in high care if

$$p - c_h - \pi\theta d + \delta(1 - \pi\theta)V_s^+ + \delta\pi\theta V_s^-$$
$$\geq p - c_l - (1 - \pi)\theta d + \delta(1 - \pi)\theta V_s^- + \delta(1 - (1 - \pi)\theta)V_s^+$$

which, after simplification, becomes

$$\delta(V_s^+ - V_s^-) \geq \frac{c_h - c_l}{\theta(1 - 2\pi)} - d$$

When we find the expression for V_s^+ and substitute in the expression for p, the inequality becomes

$$\delta(1 - \delta^T)\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta} \geq \frac{c_h - c_l}{\theta(1 - 2\pi)} - d$$

If, on the other hand, the firm were to allow both high and low litigation cost consumers to bring suit when quality is low ($d \geq k_h$), the comparable incentive condition is

$$\delta(1 - \delta^T)\frac{E(v|c_h) - c_h - E(k)}{(1 - \delta) + (1 - \delta^T)\delta\pi} \geq \frac{c_h - c_l}{(1 - 2\pi)} - d$$

Note that, holding everything else constant, (1) the firm's per-period profit ($E(v|c_h) - c_h - E(k)$ versus $E(v|c_h) - c_h - \pi\theta k_l$) is lower due to higher expected litigation cost; (2) the discount rate is higher because faulty punishment is more likely ($(1 - \delta) + (1 - \delta^T)\delta\pi$ versus $(1 - \delta) + (1 - \delta^T)\delta\pi\theta$); but (3) the amount of formal sanctions necessary is smaller ($\frac{c_h - c_l}{(1 - 2\pi)}$

18

versus $\frac{c_h - c_l}{\theta(1 - 2\pi)}$).

Now suppose, we are in a fault-based regime. The basic analysis is similar. We need $d \in [\frac{k_l}{\sigma}, \frac{k_h}{\sigma})$ for only the low litigation consumers to sue when quality is low. The firm's discounted payoff from high care (effort) becomes

$$V_n^+ = p - c_h - \pi\theta\sigma d + (1 - \pi\theta\sigma)\delta V_n^+ + \pi\theta\sigma\delta V_n^-$$

with $V_n^- = \delta^T V_n^+$ as the discounted payoff from deviation (low care). The firm exerts high care (effort) if

$$p - c_h - \pi\theta\sigma d + (1 - \pi\theta\sigma)\delta V_n^+ + \pi\theta\sigma\delta V_n^-$$
$$\geq p - c_l - (1 - \pi)\theta(1 - \sigma)d + \delta(1 - \pi)\theta(1 - \sigma)V_n^- + \delta(1 - (1 - \pi)\theta(1 - \sigma))V_n^+$$

which, after simplification, becomes

$$\delta[V_n^+ - V_n^-] \geq \frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]} - d$$

When we substitute in the expression for V_s^+ and p, the inequality becomes

$$\delta(1 - \delta^T)\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta) + \pi\sigma\theta\delta(1 - \delta^T)} \geq \frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]} - d$$

If the firm were to allow all consumers to sue ($d \geq \frac{k_h}{\sigma}$) when quality is low, the inequality becomes

$$\delta(1 - \delta^T)\frac{E(v|c_h) - c_h - E(k)}{(1 - \delta) + \pi\sigma\theta\delta(1 - \delta^T)} \geq \frac{c_h - c_l}{[(1 - \pi)(1 - \sigma) - \pi\sigma]} - d$$

As in the no-fault regime, (1) the firm's per-period profit ($E(v|c_h) - c_h - E(k)$ versus $E(v|c_h) - c_h - \pi\theta k_l$) is lower due to higher expected litigation cost; (2) the discount rate is higher because faulty punishment is more likely ($(1 - \delta) + \pi\sigma\delta(1 - \delta^T)$ versus $(1 - \delta) + \pi\sigma\theta\delta(1 - \delta^T)$); but (3) the amount of formal sanctions necessary is smaller ($\frac{c_h - c_l}{[(1 - \pi)(1 - \sigma) - \pi\sigma]}$ versus $\frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]}$).

In either liability regime, when $E(v|c_h) - c_h - E(k) < 0$, allowing both types of litigants to sue is not possible and allowing only the low-cost litigants to sue will (weakly) dominate. Assume $E(v|c_h) - c_h - E(k) \geq 0$. Suppose we are in a no-fault (strict liability) regime. We need to examine two different regions. First, suppose $k_h \geq \frac{c_h - c_l}{(1 - 2\pi)}$. Then, it is not possible to allow both types of consumers to sue and for the firm to rely on both formal and informal sanctions, since $d \geq k_h \geq \frac{c_h - c_l}{(1 - 2\pi)}$ implies that formal sanctions are sufficient. Second, suppose $k_h < \frac{c_h - c_l}{(1 - 2\pi)}$. By setting $d = \frac{c_h - c_l}{(1 - 2\pi)}$, the firm can rely only on formal sanctions and earn a discounted payoff of $\frac{E(v|c_h) - c_h - E(k)}{(1 - \delta)}$. This dominates relying on both formal and informal sanctions and allowing both types of consumers to sue by setting

19

$d \in \left[k_h, \frac{c_h - c_l}{(1 - 2\pi)} - \varepsilon \right)$, since if it were to do so, the discounted payoff becomes $\frac{E(v|c_h) - c_h - E(k)}{(1-\delta) + (1-\delta^T)\delta\pi}$ which is strictly smaller than $\frac{E(v|c_h) - c_h - E(k)}{(1-\delta)}$ $\forall T \geq 1$. Hence, when the firm relies on both informal and formal sanctions, the firm will allow only the low-cost litigants to sue when quality is low. Analysis for the fault-based regime is comparable: instead of $\frac{c_h - c_l}{(1 - 2\pi)}$, we have $\frac{\sigma(c_h - c_l)}{[(1-\pi)(1-\sigma) - \pi\sigma]}$ as the relevant threshold on k_h. ∎

Proof of Proposition 1. First, suppose $E(v|c_h) - c_h - \pi E(k) < 0$. If $k_h > \frac{c_h - c_l}{\theta(1 - 2\pi)}$, using only the formal sanctions is optimal. By setting $d = \frac{c_h - c_l}{\theta(1 - 2\pi)}$, the firm ensures that only the low-litigation-cost consumer sues the firm when quality is low and this also provides sufficient care incentive:

$$p - c_h - \pi\theta d \geq p - c_l - (1 - \pi)\theta d \Longrightarrow d \geq \frac{c_h - c_l}{\theta(1 - 2\pi)}$$

In each period, the firm expects to make $E(v|c_h) - c_h - \pi\theta k_l$ by setting $p = E(v|c_h) + \pi\theta(d - k_l)$ and the present value of all future profits is

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta)}$$

If, on the other hand, the firm were to rely on both formal and informal sanctions, the firm will have to set $d = \frac{c_h - c_l}{\theta(1 - 2\pi)} - \varepsilon$ and the firm's present value of all future profits becomes

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta}$$

Since $\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta)} > \frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^T)\delta\pi\theta}$, the firm will rely only on formal sanctions. If $k_h \leq \frac{c_h - c_l}{\theta(1 - 2\pi)}$, relying only on formal sanctions is not feasible since whenever the firm sets $d \geq \frac{c_h - c_l}{\theta(1 - 2\pi)}$ to provide care incentive, both types of consumers will sue and the firm will not serve the market. The firm can rely on both formal and informal sanctions by setting $d = k_h - \varepsilon$. Only the low-litigation-cost consumers will sue and the firm's present value of all future profits will be

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta}$$

Now suppose that $E(v|c_h) - c_h - \pi E(k) \geq 0$. When $k_h > \frac{c_h - c_l}{\theta(1 - 2\pi)}$, as before, relying only on formal sanctions clearly dominates. When $k_h \leq \frac{c_h - c_l}{\theta(1 - 2\pi)}$, relying only on formal sanctions implies setting $d = \frac{c_h - c_l}{1 - 2\pi}$ when $k_h \leq \frac{c_h - c_l}{1 - 2\pi}$ and $d = k_h$ when $\frac{c_h - c_l}{1 - 2\pi} < k_h \leq \frac{c_h - c_l}{\theta(1 - 2\pi)}$. In both cases, the firm's present value of all future profits is

$$\frac{E(v|c_h) - c_h - \pi E(k)}{(1 - \delta)}$$

20

If the firm were to rely on both formal and informal sanctions, the firm can set $d = k_h - \varepsilon$ and allow only the low-litigation-cost consumers to sue when quality is low. By doing so, the firm's present value of all future profits is

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta}$$

Note that $\frac{E(v|c_h)-c_h-\pi\theta k_l}{(1-\delta)+(1-\delta^T)\delta\pi\theta}$ increases as T gets smaller, implying that the consumers should choose the minimum punishment period necessary to satisfy the care incentive constraint of $\delta(1-\delta^T)\frac{E(v|c_h)-c_h-\pi\theta k_l}{(1-\delta)+(1-\delta^T)\delta\pi\theta} \geq \frac{c_h-c_l}{\theta(1-2\pi)} - d$. Furthermore,

$$sign\left(\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta} - \frac{E(v|c_h) - c_h - \pi E(k)}{(1 - \delta)}\right)$$

$$= sign\left((1-\delta)\pi(1-\theta)k_h - \delta\pi\theta(E(v|c_h) - c_h - \pi E(k))\right)$$

Since $(1-\delta)\pi(1-\theta)k_h > 0$, $(1-\delta)\pi(1-\theta)k_h - \delta\pi\theta(E(v|c_h)-c_h-\pi E(k))$ is strictly positive when $E(v|c_h) - c_h - \pi E(k)$ is small. ∎

Proof of Proposition 2. First, suppose $E(v|c_h) - c_h - \pi E(k) < 0$. If $k_h > \frac{\sigma(c_h-c_l)}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]}$, using only the formal sanctions is optimal. By setting $d = \frac{c_h-c_l}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]}$, the firm ensures that only the low-litigation-cost consumer sues the firm when quality is low and this also provides sufficient care incentive since

$$p - c_h - \pi\theta\sigma d \geq p - c_l - (1 - \pi)\theta(1 - \sigma)d \Longrightarrow d \geq \frac{c_h - c_l}{\theta[(1 - \pi)(1 - \sigma) - \pi\sigma]}$$

In each period, the firm expects to make $E(v|c_h)-c_h-\pi\theta k_l$ by setting $p = E(v|c_h)+\pi\theta(d-k_l)$ and the present value of all future profits is

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta)}$$

By comparison, if the firm were to rely on both formal and informal sanctions, the firm will have to set $d = \frac{c_h-c_l}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]} - \varepsilon$ and the firm's present value of all future profits becomes

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1 - \delta) + (1 - \delta^T)\delta\pi\theta\sigma}$$

Since $\frac{E(v|c_h)-c_h-\pi\theta k_l}{(1-\delta)} > \frac{E(v|c_h)-c_h-\pi\theta k_l}{(1-\delta)+(1-\delta^T)\delta\pi\theta\sigma}$, the firm will rely only on formal sanctions. If $k_h \leq \frac{\sigma(c_h-c_l)}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]}$, on the other hand, relying only on formal sanctions is not feasible since whenever the firm sets $d \geq \frac{c_h-c_l}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]}$, both types of consumers will sue and the firm will not serve the market because $E(v|c_h) - c_h - \pi E(k) < 0$. The firm can rely on both formal and informal sanctions by setting $d = \frac{k_h}{\sigma} - \varepsilon$. Only the low-litigation-cost

21

consumers will sue. The firm's present value of all future profits will be

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^T)\delta\pi\theta\sigma}$$

Now suppose that $E(v|c_h) - c_h - \pi E(k) \geq 0$. When $k_h > \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]}$, as before, relying only on formal sanctions clearly dominates. When $k_h \leq \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]}$, relying only on formal sanctions implies setting $d = \frac{c_h - c_l}{(1-\pi)(1-\sigma)-\pi\sigma}$ when $k_h \leq \frac{\sigma(c_h - c_l)}{(1-\pi)(1-\sigma)-\pi\sigma}$ and $d = \frac{k_h}{\sigma}$ when $\frac{\sigma(c_h - c_l)}{(1-\pi)(1-\sigma)-\pi\sigma} < k_h \leq \frac{\sigma(c_h - c_l)}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]}$. In both cases, consumers always sue the firm when the quality is low. The firm's present value of all future profits is

$$\frac{E(v|c_h) - c_h - \pi E(k)}{(1-\delta)}$$

If the firm were to rely on both formal and informal sanctions, the firm can set $d = \frac{k_h}{\sigma} - \varepsilon$ and allow only the low-litigation-cost consumers to sue when quality is low. By doing so, the firm's present value of all future profits is

$$\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^T)\delta\pi\theta\sigma}$$

Note that $\frac{E(v|c_h)-c_h-\pi\theta k_l}{(1-\delta)+(1-\delta^T)\delta\pi\theta\sigma}$ increases as T gets smaller, implying that the consumers should choose the minimum punishment period necessary to satisfy the care incentive constraint of $\delta(1-\delta^T)\frac{E(v|c_h)-c_h-\pi\theta k_l}{(1-\delta)+\pi\sigma\theta\delta(1-\delta^T)} \geq \frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]} - d$. Furthermore,

$$sign\left(\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^T)\delta\pi\theta\sigma} - \frac{E(v|c_h) - c_h - \pi E(k)}{(1-\delta)}\right)$$
$$= sign\left((1-\delta)\pi(1-\theta)k_h - \delta\pi\theta\sigma(E(v|c_h) - c_h - \pi E(k))\right)$$

Since $(1-\delta)\pi(1-\theta)k_h > 0$, $(1-\delta)\pi(1-\theta)k_h - \delta\pi\theta\sigma(E(v|c_h) - c_h - \pi E(k))$ is strictly positive when $E(v|c_h) - c_h - \pi E(k)$ is sufficiently small. ∎

Proof of Proposition 3. Define $\Lambda(T,\pi)$ as

$$\Lambda(T,\pi) \equiv \delta(1-\delta^T)\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^T)\delta\pi\theta} - \left(\frac{c_h - c_l}{\theta(1-2\pi)} - k_h\right)$$

$\Lambda(T,\pi) \geq 0$ is the incentive compatibility constraint when the firm uses a no-fault regime where d is substituted with k_h. Similarly, define $\Theta(T,\pi,\sigma)$ as

$$\Theta(T,\pi,\sigma) \equiv \delta(1-\delta^T)\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + \pi\sigma\theta\delta(1-\delta^T)} - \left(\frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma)-\pi\sigma]} - \frac{k_h}{\sigma}\right)$$

22

$\Theta(T, \pi, \sigma) \geq 0$ is the incentive compatibility constraint when the firm uses a fault regime with $d = \frac{k_h}{\sigma}$. Let T^* be the minimum number of punishment periods such that $\Lambda(T^*, \pi) \geq 0$. Let T^{**} be the minimum number of punishment periods such that $\Theta(T^{**}, \pi, \sigma) \geq 0$.

Claim 1 *If $\Lambda(T, \pi) > \Theta(T, \pi, \sigma)$ $\forall T$, $T^{**} > T^*$.*

* **Proof of Claim 1.** Suppose not. That is, suppose that $T^* > T^{**}$ under the condition that $\Lambda(T, \pi) > \Theta(T, \pi, \sigma)$. Since both $\Theta(T, \pi, \sigma)$ and $\Lambda(T, \pi)$ increase in T, in that case, we have $\Lambda(T^*, \pi) > \Lambda(T^{**}, \pi) > \Theta(T^{**}, \pi, \sigma) \geq 0$, a contradiction of the assumption that T^* is the minimum number of periods where no fault generates incentive compatibility. Therefore, if $\Lambda(T, \pi) > \Theta(T, \pi, \sigma)$ $\forall T$, the necessary punishment period for the no-fault regime is less than the punishment period for the fault-based regime. If $\Theta(T, \pi, \sigma) > \Lambda(T, \pi)$ $\forall T$, the reverse will be true.* ∎

Now, consider the case where $\pi = \varepsilon$, where $\varepsilon > 0$ but small. Then,

$$\Lambda(T, \varepsilon) = \delta(1 - \delta^T) \frac{E(v|c_h) - c_h - \varepsilon \theta k_l}{(1 - \delta) + (1 - \delta^T)\varepsilon \delta \theta} - \left(\frac{c_h - c_l}{\theta(1 - 2\varepsilon)} - k_h \right)$$

$$\Theta(T, \varepsilon, \sigma) = \delta(1 - \delta^T) \frac{E(v|c_h) - c_h - \varepsilon \theta k_l}{(1 - \delta) + \varepsilon \sigma \theta \delta(1 - \delta^T)} - \left(\frac{c_h - c_l}{\theta[(1 - \varepsilon)(1 - \sigma) - \varepsilon \sigma]} - \frac{k_h}{\sigma} \right)$$

We need to show that $\Lambda(T, \varepsilon) - \Theta(T, \varepsilon, \frac{1}{2}) > 0$, where $\Lambda(T, \varepsilon) - \Theta(T, \varepsilon, \frac{1}{2})$ is given by

$$\Lambda(T, \varepsilon) - \Theta(T, \varepsilon, \frac{1}{2})$$
$$= \delta(1 - \delta^T)(p - c_h) \left(\frac{1}{(1 - \delta) + (1 - \delta^T)\delta \varepsilon \theta} - \frac{1}{(1 - \delta) + \frac{1}{2}\varepsilon \theta \delta(1 - \delta^T)} \right) - k_h + \left(\frac{c_h - c_l}{\theta(1 - 2\varepsilon)} \right)$$

When we collect the terms and simplify, we get

$$\Lambda(T, \varepsilon) - \Theta(T, \varepsilon, \frac{1}{2})$$
$$= (p - c_h) \left(\frac{-\frac{1}{2}\theta[\delta(1 - \delta^T)]^2}{\left[\frac{(1-\delta)^2}{\varepsilon} + (1 - \delta^T)\delta \theta(1 - \delta) + \frac{1}{2}\theta \delta(1 - \delta^T)(1 - \delta) + \frac{1}{2}\theta \delta(1 - \delta^T)(1 - \delta^T)\delta \varepsilon \theta \right]} \right)$$
$$- k_h + \left(\frac{c_h - c_l}{\theta(1 - 2\varepsilon)} \right)$$

In this expression, $p = (1 - \varepsilon)v_h + \varepsilon v_l - \varepsilon \theta k_l$. It follows that $(p - c_h) > 0$ for small values of ε. We can thus make the first term as small as possible by taking ε arbitrarily close to zero (small values of ε make the denominator larger, the numerator remains a negative number). The second term is strictly positive when ε arbitrarily close to zero, meaning making the expression positive for an arbitrarily small π.

23

Now, fix π and consider decreasing σ. Changes in σ has no effect on $\Lambda(T, \pi)$. From $\Theta(T, \pi, \sigma)$, we know that $\frac{\partial}{\partial \sigma} \frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + \pi\sigma\theta\delta(1-\delta^T)} < 0$ and $\frac{\partial}{\partial \sigma}\left(\frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]} - \frac{k_h}{\sigma}\right) < 0$. In fact, since $\frac{k_h}{\sigma} \longrightarrow \infty$ when $\sigma \longrightarrow 0$ while $\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + \pi\sigma\theta\delta(1-\delta^T)}$ and $\frac{c_h - c_l}{\theta[(1-\pi)(1-\sigma) - \pi\sigma]}$ are bounded, $\Theta(T, \pi, \sigma) \longrightarrow \infty$ as $\sigma \longrightarrow 0$. Hence, fault-based regime dominates the no-fault regime as σ approaches zero. ■

Proof of Corollary 1. Suppose the firm sets $d = 0$. With the assumption that consumers observe the quality realized in all previous periods, to solve the incentive problem we need

$$\delta(1 - \delta^{\widetilde{T}})\frac{E(v|c_h) - c_h}{(1-\delta) + (1-\delta^{\widetilde{T}})\delta\pi} \geq \frac{c_h - c_l}{(1-2\pi)}$$

where consumers engage in informal sanctions against the firm for $\widetilde{T}$ periods once they find out that the realized quality is low in the previous period. In comparison, when the firm was relying on both formal and informal sanctions and letting only the low cost litigants to sue under the no-fault regime, the incentive condition was

$$\delta(1 - \delta^{\widehat{T}})\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^{\widehat{T}})\delta\pi} \geq \frac{c_h - c_l}{(1-2\pi)} - \theta d$$

The inequality is derived based on the assumptions that (1) the (future) consumers engage in informal sanctions for $\widehat{T}$ periods when the firm provides low quality in the current period but (2) the current consumer manages to sue the firm and recover damages only when the cost of litigation is low (reason why d is multiplied by θ on the right hand side).

Whenever $\widehat{T} = \widetilde{T}$, $\delta(1-\delta^{\widetilde{T}})\frac{E(v|c_h) - c_h}{(1-\delta) + (1-\delta^{\widetilde{T}})\delta\pi} > \delta(1-\delta^{\widehat{T}})\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^{\widehat{T}})\delta\pi}$. The presence of $-\theta d$ on the right hand side of the second inequality, however, implies that as d rises $\widehat{T}$ falls, raising $\delta(1 - \delta^{\widehat{T}})\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^{\widehat{T}})\delta\pi}$. When $\pi \to 0$, the left hand side expressions converge to each other for any $T = \widehat{T} = \widetilde{T}$, while smaller $\widehat{T}$ implies that $\delta(1-\delta^{\widehat{T}})\frac{E(v|c_h) - c_h - \pi\theta k_l}{(1-\delta) + (1-\delta^{\widehat{T}})\delta\pi} > \delta(1-\delta^{\widetilde{T}})\frac{E(v|c_h) - c_h}{(1-\delta) + (1-\delta^{\widetilde{T}})\delta\pi}$. That is, relying on both formal and informal sanctions will dominate. Similarly, when $k_l \to 0$, it becomes easier to satisfy the second inequality than the first, again making it more advantageous for the firm to rely on both types of sanctions. ■

References

[1] Alexander, C. "On the Nature of the Reputational Penalty for Corporate Crime: Evidence." *Journal of Law and Economics*, Vol. 42 (1999), pp. 489–526.

[2] Bakos, Y. and Dellarocas, C. "Cooperation Without Enforcement? A Comparative Analysis of Litigation and Online Reputation as Quality Assurance Mechanisms." *Management Science*, Vol. 57 (2011), pp. 1944–1962.

[3] Bebchuk, L. and Posner, R. "One-sided Contracts in Competitive Consumer Markets." *Michigan Law Review*, Vol. 104 (2006), pp. 827–835.

[4] Bernstein, L. "Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry." *Journal of Legal Studies*, Vol. 21 (1992), pp. 115–157.

[5] Bohnet, I., Frey, B. and Huck, S. "More Order with Less Law: On Contractual Enforcement, Trust, and Crowding." *American Political Science Review*, Vol. 95 (2001), pp. 131–144.

[6] Cai, H. and Obara, I. "Firm Reputation and Horizontal Integration." *RAND Journal of Economics*, Vol. 40 (2009), pp. 340–363.

[7] Cooter, R. and Porat, A. "Should Courts Deduct Nonlegal Sanctions from Damages?" *Journal of Legal Studies*, Vol. 30 (2001), pp. 401–422.

[8] Cripps, M., Mailath, G., and Samuelson, L. "Imperfect Monitoring and Impermanent Reputations." *Econometrica*, Vol. 72(2) (2004), pp. 407–432.

[9] Deci, E., Koestner, R. and Ryan, R. "A Meta-Analytic Review of Experiments Examining the Effects of Extrinsic Rewards on Intrinsic Motivation." *Psychological Bulletin*, Vol. 125 (1999), pp. 627–668.

[10] Ellickson, R. *Order Without Law: How Neighbors Settle Disputes*. Cambridge, Mass: Harvard University Press, 1991.

[11] Fudenberg, D. and Tirole, J. *Game Theory*. Cambridge, Mass: The MIT Press, 1996.

[12] Ganuza, J., Gomez, F. and Robles, M. "Product Liability versus Reputation." Working Paper, 2011.

[13] Gilson, R., Sabel, C. and Scott, R. "Braiding: The Interaction of Formal and Informal Contracting in Theory, Practice, and Doctrine." *Columbia Law Review*, Vol. 110 (2010), pp. 1377–1447.

[14] Karpoff, J., Lee, D. and Vendrzyk, V. "Defense Procurement Fraud, Penalties, and Contractor Influence." *Journal of Political Economy*, Vol. 107 (1999), pp. 809–842.

[15] Katz, A. "Your Terms or Mine? The Duty to Read the Fine Prints in Contracts." *RAND Journal of Economics*, Vol. 21 (1990), pp. 518–537.

[16] Klein, B. "Why Hold-Ups Occur: The Self-Enforcing Range of Contractual Relationships." *Economic Inquiry*, Vol. 34 (1996), pp. 444–463.

[17] Klein, B. and Leffler, K. "The Role of Market Forces in Assuring Contractual Performance." *Journal of Political Economy*, Vol. 89 (1981), pp. 615–641.

[18] Korobkin, R. "Bounded Rationality, Standard Form Contracts, and Unconscionability." *University of Chicago Law Review*, Vol. 70 (2003), pp. 1203–1295.

[19] Mahoney, P. and Sanchirico, C. "Norms, Repeated Games, and the Role of Law." *California Law Review*, Vol. 91 (2003), pp. 1281–1329.

[20] MacLeod, B. and Malcomson, J. "Implicit Contracts, Incentive Compatibility, and Involuntary Unemployment." *Econometrica*, Vol. 57 (1989), pp. 447–480.

[21] MacLeod, B. "Reputations, Relationships, and Contract Enforcement." *Journal of Economic Literature*, Vol. 35 (2007), pp. 595–628.

[22] Milgrom, P., North, D. and Weingast, B. "The Role of Institutions in the Revival of Trade: The Law Merchant, Private Judges, and the Champagne Fairs." *Economics and Politics*, Vol. 2 (1990), pp. 1–23.

[23] Nalebuff, B. "Credible Pretrial Negotiation." *RAND Journal of Economics*, Vol. 18 (1987), pp. 198–210.

[24] Polinsky, A. and Shavell, S. "The Uneasy Case for Product Liability." *Harvard Law Review*, Vol. 123 (2010), pp. 1437–1492.

[25] Richman, B. "Firms, Courts, and Reputational Mechanisms: Towards a Positive Theory of Private Ordering." *Columbia Law Review*, Vol. 104 (2004), pp. 2328–2368.

[26] Roberts, J. "Can Warranties Substitute for Reputations?" *American Economic Journal: Microeconomics*, Vol. 3 (2011), pp. 69–85.

[27] Scott, R. "Conflict and Cooperation in Long-Term Contracts." *California Law Review*, Vol. 75 (1987), pp. 2005–2054.

[28] Scott, R. "A Theory of Self-Enforcing Indefinite Agreements." *Columbia Law Review*, Vol. 103 (2003), pp. 1641–1699.

[29] Shapiro, C. "Premiums for High Quality Products as Returns to Reputations." *Quarterly Journal of Economics*, Vol. 98 (1983), pp. 659–680.

[30] Shavell, S. "Strict Liability Versus Negligence." *Journal of Legal Studies*, Vol. 9 (1980), pp. 1–26.