

Negligence, Ignorance and the Demand for Liability Insurance

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ABSTRACT

This paper considers whether lack of information regarding risk exposures can lead to a demand for negligence liability insurance. We find that, under the uniform negligence rule, any demand for liability insurance must come from informed individuals. The group whose privately optimal level of care is below the negligence standard may find it less costly to be negligent and purchase insurance. Under the individualized negligence rule, the demand for insurance, if any, comes from uninformed individuals, and the information disclosure environment is a critical determinant of whether there is a demand for liability insurance or not.

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1. Introduction and Background

The law of negligence holds injurers responsible for the damages they inflict on their victims only if they have not met the applicable standard of care. Under U.S. law, the standard usually applied is called the “reasonable person” standard. Under this rule, if the level of care taken is consistent with that which would have been taken by a reasonable person, then there is no liability and the victim bears the full cost of his or her injuries. Thus, if a person takes appropriate care, there is no reason to purchase liability insurance¹.

The existence of a thriving market for negligence liability insurance, including both personal and commercial lines, implies that the current structure of liability law exposes market participants to some type of risk that can be managed more cost-effectively by purchasing insurance. For some types of negligence, the market for liability insurance is the result of legal (e.g., auto) or contractual (e.g., homeowners) requirements. The markets for other types of negligence liability insurance, such as medical malpractice, professional liability, and commercial general liability insurance, are more difficult to explain since knowledge of the standard of care would imply that every potential injurer could simply meet the standard of care and would never be liable.

Shavell (2000, pp. 171-172), reflecting widely held views, argues that insurance is purchased against risks due to the uncertain operation of the legal system, risks due to momentary lapses in care and risks due to the negligent behavior of agents. Crocker and

¹ Brown (1973) shows that (risk neutral) agents will meet the negligence standard if it is set optimally. Shavell (1982) shows that this implies risk averse agents will not purchase liability insurance.

Doherty (2000) argue that potential injurers' lack of knowledge about risks they face may provide a motive for the purchase of liability insurance. They assume that potential injurers can cause either small or large damages in the event of an accident. The legal standard of care is assumed to depend on the size of the damages, that is, on the potential injurers' type. However, Crocker and Doherty assume that potential injurers do not know their type and hence do not know the appropriate level of care to take. In their analysis, potential injurers are allowed to learn their type at zero cost. Thus, potential injurers face a choice between becoming informed and taking appropriate precautions or remaining uninformed and purchasing liability insurance. Liability insurance allows the potential injurer to hedge the "classification risk," that is, the risk associated with the unknown cost of meeting the standard of due care.

Crocker and Doherty's work can be viewed as an extension of Shavell's (1992) analysis of the effect of liability law on potential injurers' incentives to become informed about potential risks and to take care. Shavell considers several negligence rules, where liability may depend on both the decision to become informed and the level of care or may depend solely on the level of care. Negligence rules that require or assume optimal acquisition of information lead to optimal acquisition of information and optimal care. Other negligence rules may result in too much or too little information and consequently, in too much or too little care. However, Shavell does not consider the implications for insurance markets.

We examine the issue of whether individual's lack of information regarding the risks they face can lead to a demand for liability insurance. We do so under a broad range of assumptions about the negligence rule, about what potential injurers do not

know, and about the information disclosure environment. Specifically, we analyze models in which, as in Crocker and Doherty, individuals are initially uninformed about their characteristics but have the opportunity to learn about their type, to purchase insurance, and to take care. We consider the uniform negligence rule, where all individuals must meet the same standard of due care (the “reasonable person” standard); this is the dominant negligence standard in the United States. We also consider individualized negligence rules, where the standard of care depends on the potential injurer’s type. We analyze situations in which individuals are initially uninformed about their probability of having an accident (their risk-type) and situations in which they know the accident probability but are uninformed about their cost of care (their cost-type). We also examine the effect of the information disclosure environment, that is, the ability of potential injurers to credibly communicate their risk type and their informed/uninformed status to insurers. We seek to answer two questions. Under what conditions do potential injurers become informed? Whether or not they become informed, under what conditions do potential injurers buy liability insurance?

We find that, under the uniform negligence rule, the value of information is positive, hence, the outcome is the same as if potential injurers were initially informed. Potential injurers whose privately optimal level of care is below the negligence standard purchase insurance. The necessary condition is that it is less costly to be negligent and purchase insurance than to be non-negligent. In contrast, under the individualized negligence rule, the value of information and the demand for insurance depend critically on the information disclosure environment. If insurers can determine potential injurers’ information (informed/uninformed) status then the value of information is negative and

uninformed potential injurers purchase insurance. However, if insurers cannot determine information status, the value of information is positive, potential injurers comply with the negligence standards and there is no demand for liability insurance.

The next section describes the basic assumptions of the model, defines the negligence rules and the value of information. The third and fourth sections analyze the incentives to become informed and to insure under the uniform and individualized negligence rules, assuming that individuals do not know their accident probabilities. The fifth section evaluates the outcomes when individuals do not know their cost of care. The final section provides brief concluding remarks.

2. The Basic Model.

2.1 Assumptions. The analytical model is an extension of the standard model of accidents in the law and economics literature (e.g., Shavell 1982, 1987). For simplicity, we assume that accidents are unilateral, that is, only the potential injurer's care affects the probability of an accident. We also assume the accidents are "between strangers," that is, there is no contractual relationship that the potential victim can use to provide incentives for the potential injurer to take care.

Let x denote the potential injurer's expenditure on accident prevention or "care." Let $\pi_G(x)$ (resp., $\pi_B(x)$) be the probability of an accident when a "good risk" type (resp., "bad risk" type) spends x on care. The probability of an accident is a strictly decreasing, strictly convex function of expenditure on care. The good risk types have a lower accident probability than the bad risk types for any expenditure on care, $0 < \pi_G(x) < \pi_B(x)$

< 1 , and have a higher marginal product of care, $\pi'_G(x) > \pi'_B(x)$. Let θ_G and θ_B be the proportions of good and bad risks and let d be the damage suffered by victims.

An important aspect of the analysis here is that potential injurers do not necessarily know whether they are good risks or bad risks.² However, they do know that they are good risk or bad risks with probabilities θ_G and θ_B . We use the subscript U to denote uninformed potential injurers. Then uninformed potential injurers estimate their probability of an accident as $\pi_U(x) = \theta_G\pi_G(x) + \theta_B\pi_B(x)$.

Potential injurers have initial wealth $w > d$ and the von Neuman-Morgenstern utility function u , which is strictly increasing and strictly concave. Potential victims have initial wealth y . We assume potential victims are risk neutral, since this leads to a simple characterization of the liability rule. Individuals know whether they are a potential injurer or a potential victim.

An insurance policy consists of a premium, p , and an indemnity, q , paid in the event the policyholder is liable for damages to a victim. A potential injurer who buys the insurance policy (p_i, q_i) and expends x_i on care therefore has expected utility given by

$$U_i(p_i, q_i, x_i) = (1 - \pi_i(x_i))u(w - p_i - x_i) + \pi_i(x_i)u(w - p_i - x_i - d + q_i) \quad (2.1)$$

for $i = B, G, U$.

We assume that the liability standard is perfectly enforced so that there is no uncertainty in the definition or application of the negligence rule. This implies that victims, courts, and insurers can perfectly verify both the injurer's type and the injurer's level of care if an accident occurs. Since victims and courts can verify the injurer's care, we assume care is observable. This implies that the insurance premium can depend on

² We can extend the models analyzed here to allow a portion of the potential injurers to be exogenously informed. This does not change any of the results in the paper.

the level of care.³ We assume throughout that the insurance market is competitive and that insurers earn zero expected profit, given the information they have about policyholders. The zero expected profit constraint is then $p_i = \pi_i(x)q_i$, $i = B, G, U$. Since the premium is actuarially fair, if potential injurers insure, they will choose full coverage ($q = d$) and choose the level of care that minimizes the total cost of accidents and care, $x_i^* = \operatorname{argmin} x_i + \pi_i(x_i)d$.

The timing of the model is as shown in Figure 1. Potential injurers, victims and the courts are initially symmetrically uninformed about whether injurers are good or bad risks. Potential injurers then have the opportunity to learn their type. Potential injurers may then purchase liability insurance. We consider the case where the potential injurer can provide verifiable proof of their type to the insurance company. We also consider cases where the potential injurer can provide less information to the insurance company. After the potential injurers have decided whether or not to buy insurance, they choose their expenditure on care; the expenditure on care is observable. Nature then determines whether or not an accident occurs. If an accident occurs, the courts costlessly determine the injurer's type and apply the negligence rule to determine liability.

2.2 Negligence Rules. A uniform negligence rule applies the same standard of due care to all potential injurers.

Definition 1: Under the uniform negligence rule, an injurer is negligent if $x < x_U^*$, where

$$x_U^* = \operatorname{argmin} x_U + \pi_U(x_U)d. \quad (2.2)$$

³ We are making an assumption about timing, namely that care is observed *ex ante* so that the premium can depend on care. However, under the alternative assumption that care is only observed *ex post* in the event of an accident, the indemnity can depend on the level of care.

This is the well-known Hand Rule, that injurers are negligent if the social burden of the untaken precaution is less than the expected social harm. Thus, injurers are fully liable for damages to victims and the standard of care minimizes the total cost of accidents and care. Shavell (1982) shows that, if injurers are identical and victims are risk neutral, the uniform negligence rule achieves the first best outcome. Also, since potential injurers meet the standard of care and are never negligent, they bear no risk. It is interesting to note that Shavell (2000) does not consider this particular version of the negligence rule in his analysis.

The individualized negligence rule sets different standards of care, x_G^* and x_B^* , for good risks and bad risks.

Definition 2: Under the individualized negligence rule, an injurer is negligent if they are of risk type i and $x_i < x_i^*$, where

$$x_i^* = \operatorname{argmin} x_i + \pi_i(x_i)d, i = B, G. \quad (2.3)$$

Again, injurers are fully liable for damages to victims, the standards of care minimize the total cost of accidents and care for each type of potential injurer, as well as in the aggregate. Potential injurers meet the appropriate standard of care and bear no risk. The argument in Shavell (1982) shows that, if victims are risk neutral, then the individualized negligence rule achieves the first best outcome. Observe that the assumptions on the loss probabilities imply that $x_G^* < x_U^* < x_B^*$. Finally, whether an individual is negligent depends only on the rule employed and the individual's care, not on whether the individual is informed.

Under the uniform negligence rule, good risks are required to expend too much on care to meet the standard, while bad risks are required to expend too little. This increases the total social cost of accidents plus expenditure on care relative to the individualized

negligence rule. This leads to the question of why the uniform rule would be used. As Landes and Posner (1987, pp. 123-131) point out, the inefficiency of the uniform rule must be compared to the information costs of determining individualized standards of care. The widespread use of the reasonable person standard implies that, in most cases, these information costs are high. As they put it (p. 127) “In types of cases where the information costs of departing from the average-man standard are low because the gap between the average individual’s due care standard and that of the individual defendant is large and palpable, the courts, as predicted, recognize a different standard.”

2.3 Value of Information. We measure the value of information as the expected increase in expected utility from becoming informed. Let $z = (p, q, x)$ be the arguments of the potential injurers expected utility function. Let \hat{z}_i maximize expected utility for an individual of type $i = B, G, U$, subject to any relevant constraints. Then the value of information is the gain in expected utility from becoming informed:

$$I = \theta_G U_G(\hat{z}_G) + \theta_B U_B(\hat{z}_B) - U_U(\hat{z}_U). \quad (2.4)$$

We assume that individuals become informed if the value of information is non-negative.

A possible objection to this definition is that individuals who wish to become informed must expend resources to become informed. An alternative approach to measuring the value of information is to use the decision-maker’s willingness to pay, that is, the reduction in wealth that makes informed expected utility equal to uninformed expected utility. However, the two approaches are equivalent, that is, the value of information is positive if, and only if, willingness to pay is positive.

3. Uniform Negligence Rule

We now consider the question of whether potential injurers will become informed about their type and whether a market for liability insurance will arise when the negligence rule is uniform.

We initially assume that, if they become informed, potential injurers can provide verifiable proof of their type to the insurer. Uninformed potential injurers meet the standard of care and have utility $u(w - x_U^*)$ and have no demand for insurance. If injurers become informed and learn that they are bad risks, then they meet the standard of care and have utility $u(w - x_U^*)$. If there is a demand for liability insurance, then it must come from informed good risks.

Proposition 1: Assume a uniform negligence standard and that insurers can verify informed potential injurers' risk-type. Then a necessary and sufficient condition for (a) good risks to fully insure ($q = d$) and expend x_G^* on accident prevention and (b) the value of information to be non-negative is that ,

$$x_U^* \geq x_G^* + \pi_G(x_G^*)d. \quad (3.1)$$

Proof: (a) If injurers learn that they are good risks, then they may be better off to choose a lower level of care and insure against the resulting liability exposure. Since they can verify their type, the premium is actuarially fair, $\pi_G(x)q$. The informed good risks then fully insure and choose the level of care, x_G^* , to minimize their total cost of accidents plus expenditure on care. This yields utility $u(w - x_G^* - \pi_G(x_G^*)d)$. Informed good risks are better off purchasing insurance if, and only if, (3.1) holds. (b) Then the value of information is

$$\begin{aligned} I &= \theta_G u(w - x_G^* - \pi_G(x_G^*)d) + \theta_B u(w - x_U^*) - u(w - x_U^*). \\ &= \theta_G [u(w - x_G^* - \pi_G(x_G^*)d) - u(w - x_U^*)] \end{aligned} \quad (3.2)$$

Then the value of information is non-negative if, and only if, the inequality in (3.1) holds. If the inequality in (3.1) does not hold, then potential injurers remain uninformed, expend x_U^* on accident prevention and do not insure. ||

That is, the value of information is non-negative if the cost of complying with the negligence standard is greater than the cost of being negligent plus the cost of insurance. If the inequality in (3.1) holds, then potential injurers become informed and the informed good risks buy liability insurance. If the inequality in (3.1) is reversed, then potential injurers remain uninformed and there is no demand for liability insurance. Also, whether the inequality in (3.1) holds depends on the proportions of good and bad risks, their respective loss probabilities and damages (which determine x_G^* and x_U^*), but does not depend on potential injurers' attitudes toward risk.

If risk type is verifiable, then lack of information about risk is not an essential part of the demand for liability insurance. Suppose that, instead of being initially uninformed, all potential injurers are initially exogenously informed about their risk type. Then the bad risks meet the standard of care and the good risks insure if, and only if, the inequality in (3.1) holds. That is, the outcome is the same as if potential injurers were initially informed about their about the risk of an accident.

The insurance policy bought by the good risks is also attractive to the uninformed and to bad risks. The insurance company was able to offer the policy since it could identify the goods risks and exclude others from purchasing the policy. For example, suppose that the insurance company cannot verify whether potential injurers are informed or uninformed. Then, since it cannot exclude the uninformed, the insurance company

faces an adverse selection problem and must take this into account in designing the policy. That is, the policy must satisfy the self-selection constraint

$$U_U(\pi_G(x)q, q, x) \leq u(w - x_U^*). \quad (3.3)$$

We let \hat{q}_G denote the equilibrium level of coverage and \hat{x}_G denote the equilibrium expenditure on care by informed good risks.

Proposition 2: Assume a uniform negligence standard and that insurers cannot verify whether potential injurers are informed. Then a sufficient condition for (a) good risks to less than fully insure ($\hat{q}_G < d$) and increase expenditure on accident prevention ($\hat{x}_G > x_G^*$) and (b) the value of information to be positive is that the self-selection constraint (3.3) is binding.

Proof: (a) Let \hat{q}_G and \hat{x}_G maximize $U_G(\pi_G(x)q, q, x)$ subject to the self-selection constraint, and assume that the self-selection constraint in (3.3) is binding. Observe that if $q = d$ and $x = x_G^*$, the constraint is violated. Since the constraint is binding, we must have $\hat{q}_G < d$, and, since the good risks are less than fully insured, they increase expenditure on care, $\hat{x}_G > x_G^*$. Letting $\hat{z}_G = (\pi_G(\hat{x}_G)\hat{q}_G, \hat{q}_G, \hat{x}_G)$, informed good risks obtain expected utility $U_G(\hat{z}_G)$. Since $U_G(\hat{z}_G) > U_U(\hat{z}_G) = u(w - x_U^*)$, informed good risks are better off purchasing insurance.

(b) The value of information is

$$\begin{aligned} I &= \theta_G U_G(\hat{z}_G) + \theta_B u(w - x_U^*) - u(w - x_U^*) \\ &= \theta_G [U_G(\hat{z}_G) - u(w - x_U^*)] \end{aligned} \quad (3.4)$$

Since $U_G(\hat{z}_G) > U_U(\hat{z}_G) = u(w - x_U^*)$, the value of information is positive. ||

Alternatively, insurance companies may be able to distinguish informed from uninformed potential injurers, but may be unable to determine whether informed injurers are good or bad risks. Then the self-selection constraint becomes

$$U_B(\pi_G(x)q, q, x) \leq u(w - x_U^*). \quad (3.5)$$

Then a result analogous to Proposition 2 holds. We let \tilde{q}_G denote the coverage and \tilde{x}_G denote the expenditure on care.

Proposition 3: Assume a uniform negligence standard and that insurers can verify whether potential injurers are informed but cannot verify their type. Then a sufficient condition for (a) good risks to less than fully insure ($\tilde{q}_G < d$) and increase expenditure on accident prevention ($\tilde{x}_G > x_G^*$) and (b) the value of information to be positive is that the self-selection constraint (3.5) is binding.

This follows from the same argument as Proposition 2. Now observe that if the self-selection constraint for the informed bad risks in (3.5) is binding, then the self-selection constraint for the uninformed in (3.3) must also hold as an equality. Then we have (a) $\tilde{q}_G \leq \hat{q}_G$ and $\tilde{x}_G \geq \hat{x}_G$ with at least one strict inequality and, letting $\tilde{z} = (\pi_G(\tilde{x}_G)\tilde{q}_G, \tilde{q}_G, \tilde{x}_G)$, we have (b) $U_G(\hat{z}) > U_G(\tilde{z})$.

The inability of insurers to distinguish individuals' information status or to distinguish informed individuals' type makes the good risks worse off since $u(w - x_G^* - \pi_G(x_G^*)d) > U_G(\hat{z}) > U_G(\tilde{z})$. This fact, combined with a binding self-selection constraint in either (3.3) or (3.4), implies that the inequality in (3.1) must hold. Therefore, the inequality in (3.1) is a necessary condition for the value of information to be positive. Conversely, if the inequality in (3.1) is reversed, then regardless of the information disclosure environment, the value of information is always negative and there is no demand for liability insurance.

4. Individualized Negligence Rule.

We now consider the case of the individualized negligence rule. In this case, the standards of care are x_G^* for the good risks and x_B^* for the bad risks. As before, the premium for each risk type depends on the expenditure on care chosen. If potential injurers become informed, they can meet the appropriate standard of care, are never liable and have no reason to buy liability insurance. If potential injurers do not know whether they are a good or bad risks, then they face uncertainty over the standard of care they must meet to avoid liability. If there is a demand for liability insurance, it must arise from uninformed potential injurers.

The probability that an uninformed injurer will be found negligent depends on their expenditure on care and on the courts' *ex post* determination of their type in the event of an accident. Since $x_G^* < x_B^*$, if the potential injurer chooses to spend less than x_G^* on care, the injurer is always negligent. If the potential injurer chooses to spend between x_G^* and x_B^* , the injurer is only negligent if they are a bad risk. If the potential injurer spends at least x_B^* , the injurer is never negligent. The *ex ante* probability that an uninformed injurer will be negligent is then

$$\begin{aligned} \Pi_U(x) = \pi_U(x) & \quad \text{if } x < x_G^* \\ \theta_B \pi_B(x) & \quad \text{if } x_G^* \leq x < x_B^* \\ 0 & \quad \text{if } x_B^* \leq x \end{aligned} \tag{4.1}$$

Now consider the decision of an uninformed potential injurer to purchase insurance.

Proposition 4: Assume an individualized negligence standard, that insurers can either (1) verify an informed individual's risk type or (2) verify an individual's information status and that the uninformed purchase insurance. Then a necessary condition for (a) the uninformed to fully insure ($q = d$) and choose the expenditure on care $\hat{x}_U = \operatorname{argmin} x + \theta_B \pi_B(x)d$, (b) $x_G^* \leq \hat{x}_U < x_U^*$ and (c) the value of information to be negative is that

$$\theta_G x_G^* + \theta_B x_B^* \geq \hat{x}_U + \theta_B \pi_B(\hat{x}_U)d. \quad (4.2)$$

Proof: If insurers can verify an individual's risk type, they can verify that the individual is informed. Therefore, it is enough to consider the case where insurers can verify whether the individual is informed. (a) Since the premium is actuarially fair, individuals fully insure and choose the level of care to minimize their total cost of accidents plus care, $\hat{x}_U = \operatorname{argmin} x + \Pi_U(x)d$. That $\Pi_U(\hat{x}_U) = \theta_B \pi_B(\hat{x}_U)$ follows from part (b). (b) To show that $x_G^* < \hat{x}_U < x_U^*$ we need to show that $\theta_B \pi'_B(x_G^*)d < -1 < \theta_B \pi'_B(x_U^*)d$. From the definition of x_G^* , the first inequality can be written as $\theta_B \pi'_B(x_G^*)d < \pi'_U(x_G^*)d$. This holds if $\theta_B > \hat{\theta}_B \equiv \pi'_G(x_G^*)/\pi'_B(x_G^*)$. If $\theta_B \leq \hat{\theta}_B$, then $\hat{x}_U \leq x_G^*$. The facts that $\pi'_U(x)$ is increasing, that $x_G^* < x_U^*$ and that $\pi'_U(x_U^*)d = -1$ together imply that we cannot have $\hat{x}_U < x_G^*$. Then $\theta_B \leq \hat{\theta}_B$ implies that $\hat{x}_U = x_G^*$. Therefore, $x_G^* \leq \hat{x}_U$. The second inequality follows from the definition of $\pi_U(x)$ and the fact that $\pi'_U(x_U^*)d = -1$. Therefore, $\hat{x}_U < x_U^*$. (c) Since they fully insure, uninformed potential injurers have expected utility $u(w - \hat{x}_U - \theta_B \pi_B(\hat{x}_U)d)$. Then the value of information is

$$I = \theta_G u(w - x_G^*) + \theta_B u(w - x_B^*) - u(w - \hat{x}_U - \theta_B \pi_B(\hat{x}_U)d) \quad (4.3)$$

If the inequality in (4.2) holds, then $u(w - \theta_G x_G^* - \theta_B x_B^*) \leq u(w - \hat{x}_U - \theta_B \pi_B(\hat{x}_U)d)$.

Then the concavity of u implies the value of information is negative. ||

Crocker and Doherty (2000) also prove part (a) and that $x_G^* \leq \hat{x}_U$. However, we provide a sharper upper bound on \hat{x}_U and provide a sufficient condition for the value of information to be negative.

Proposition 4 assumes that uninformed individuals purchase insurance. Alternatively, they may choose to remain uninsured and simply exercise care. Expected utility for uninformed, uninsured individuals is $U_U(x) = (1 - \Pi(x))u(w - x) + \Pi(x)u(w - x - d)$, where $\Pi(x)$ is given by (4.1). Let \bar{x}_U be the level of care chosen by uninformed uninsured potential injurers so that $U_U(\bar{x}_U)$ is the resulting level of expected utility. Since these individuals retain some risk, we can find a risk premium, $\bar{R} > 0$, such that $u(w - \bar{x}_U - \bar{R}) = U_U(\bar{x}_U)$. Then uninformed individuals will insure if, and only if,

$$\bar{x}_U + \bar{R} > \hat{x}_U + \theta_B \pi_B(\hat{x}_U)d. \quad (4.4)$$

This inequality is more likely to hold the greater the degree of risk aversion and the smaller the proportion of bad risks in the population.

Proposition 4 also assumes that insurance companies can verify that potential injurers are uninformed. This may be difficult to do, since it is easier for the knowledgeable to feign ignorance than for the ignorant to feign knowledge. Then informed bad risks may prefer to masquerade as uninformed. This creates an adverse selection problem. The policy offered by the insurance company must satisfy the self-selection constraint

$$U_B(\Pi_U(x)q, q, x) \leq u(w - x_B^*). \quad (4.5)$$

We let \tilde{q}_U denote the level of coverage and \tilde{x}_U the expenditure on care for uninformed potential injurers.

Proposition 5: Assume an individualized negligence standard, that insurers cannot verify whether individuals are uninformed and that the uninformed purchase insurance. Then a sufficient condition for (a) the uninformed to less than fully insure ($\tilde{q}_U < d$) and increase expenditure on care ($\tilde{x}_U > \hat{x}_U$), and (b) the value of information to be positive is that the self-selection constraint (4.5) is binding.

Proof: (a) Let \tilde{q}_U and \tilde{x}_U maximize $U_U(\Pi_U(x)q, q, x)$ subject to the self-selection constraint, and assume that the self-selection constraint in (4.5) is binding. Observe that if $q = d$ and $x = \hat{x}_U$, the constraint is violated. Since the constraint is binding, we must have $\tilde{q}_U < d$, and, since the good risks are less than fully insured, they increase expenditure on care, $\tilde{x}_U > \hat{x}_U$. (b) The value of information is

$$I = \theta_G u(w - x_G^*) + \theta_B u(w - x_B^*) \quad (4.6)$$

$$- [(1 - \theta_B \tilde{\pi}_B) u(w - \tilde{x}_U - \tilde{p}_U) + \theta_B \tilde{\pi}_B u(w - \tilde{x}_U - \tilde{p}_U - d + \tilde{q}_U)],$$

where $\tilde{\pi}_B = \pi_B(\tilde{x}_U)$ and $\tilde{p}_U = \theta_B \pi_B(\tilde{x}_U) d$. Substituting from the self-selection constraint, writing out the expression for U_B and canceling like terms yields

$$I = \theta_G u(w - x_G^*) + \theta_B (1 - \tilde{\pi}_B) u(w - \tilde{x}_U - \tilde{p}_U)$$

$$- (1 - \theta_B \tilde{\pi}_B) u(w - \tilde{x}_U - \tilde{p}_U).$$

Using the fact that $\theta_G + \theta_B = 1$ and substituting into the last term, this reduces to

$$I = \theta_G [u(w - x_G^*) - u(w - \tilde{x}_U - \tilde{p}_U)] > 0. \quad \parallel$$

Crocker and Doherty prove essentially the same results, although their proof of part (b) is slightly different.

The results in Propositions 4 and 5 imply that the information disclosure environment is critically important in determining whether a market for liability insurance will develop. Proposition 4 assumes that insurers can determine whether or not

potential injurers are informed. This would seem to be possible only if there is a perfectly enforced mandatory disclosure law. Suppose there is voluntary disclosure or that the mandatory disclosure law is not perfectly enforced. Then the insurer cannot determine whether or not individuals are informed. This is the situation considered in Proposition 5. Since the value of information is positive, potential injurers become informed, meet the relevant standard of care, and have no demand for liability insurance.

5. Heterogeneous Cost of Care

In this section we assume that all potential injurers have the same known accident probabilities. However, individuals have different, initially unknown, costs of care.

5.1. Assumptions. We let s (for “safety”) denote the level of activity intended to reduce the risk of accidents. The probability of an accident is $\pi(s)$, which is strictly decreasing, strictly convex and the same for all potential injurers. Individuals can have either a high cost of care, c_H , or a low cost of care, c_L , where $0 < c_L < c_H$. Expenditure on care is then $x_i = c_i s$, $i = H, L$. We let θ_H and θ_L denote the proportions of high cost and low cost parties, and $c_U = \theta_H c_H + \theta_L c_L$. If the potential injurer buys the insurance policy (p_i, q_i) and chooses the level of care s_i , then their expected utility is

$$U_i(p_i, q_i, s_i) = (1 - \pi(s_i))u(w - p_i - c_i s_i) + \pi(s_i)u(w - p_i - c_i s_i - d_i + q_i)$$

(5.1)

for $i = H, L, U$. We retain the assumptions that the level of care is observable and that insurance companies earn zero expected profit.⁴

The negligence rules are:

⁴ Since the expenditure on care is $x_i = c_i s$, the accident probabilities as a function of expenditure are $\pi_i(x_i) = \pi(x_i/c_i)$, $i = H, L$. If π is strictly decreasing and strictly convex, then $\pi_L(x) < \pi_H(x)$ and $\pi_L'(x) > \pi_H'(x)$.

Definition 3: (a) Under the uniform negligence rule, an injurer is negligent if $s < s_U^*$, where

$$s_U^* = \operatorname{argmin} c_{US} + \pi(s)d. \quad (5.2)$$

(b) Under the individualized negligence rule, an injurer is negligent if they are of type i and $s_i < s_i^*$, where

$$s_i^* = \operatorname{argmin} c_i x_i + \pi(s)d, i = H, L. \quad (5.3)$$

The assumptions about the cost of care imply that $s_H^* < s_U^* < s_L^*$. The value of information is the gain in expected utility from becoming informed and is given by (2.4) where now $z_i = (p_i, q_i, s_i)$.

5.2. Uniform Negligence Rule. As before, uninformed potential injurers can meet the uniform standard of care, s_U^* , and avoid liability. In this case, their expected utility is either $u(w - c_{HSU}^*)$ with probability θ_H or $u(w - c_{LSU}^*)$ with probability θ_L . Informed low cost individuals can meet the standard of care, so if there is a demand for liability insurance it arises from the informed high cost of care individuals.

Proposition 6: Assume a uniform negligence standard and that insurers can verify informed potential injurers' cost of care. Then a necessary and sufficient condition for (a) high cost parties to fully insure ($q = d$) and choose care s_H^* and (b) the value of information to be non-negative is that

$$c_{HSU}^* \geq c_{HSH}^* + \pi(s_H^*)d. \quad (5.4)$$

Proof: (a) If informed high cost parties fully insure and choose the level of care, s_H^* they obtain utility $u(w - s_H^* - \pi_G(s_H^*)d)$. They are better off purchasing insurance if, and only if, (5.4) holds. (b) The value of information is

$$\begin{aligned} I &= \theta_H u(w - c_{HSH}^* - \pi(s_H^*)d) + \theta_L u(w - c_{LSU}^*) \\ &\quad - [\theta_H u(w - c_{HSU}^*) + \theta_L u(w - c_{LSU}^*)]. \\ &= \theta_H [u(w - c_{HSH}^* - \pi(s_H^*)d) - u(w - c_{HSU}^*)] \end{aligned} \quad (5.5)$$

The value of information is non-negative if, and only if, the inequality in (5.4) holds. ||

Proposition 6 assumes that the insurance company can determine whether individuals are informed and can determine the cost of care of informed individuals. If individuals have different accident probabilities then, as we have seen, adverse selection problems can arise when insurers cannot verify potential injurers' risk type. However, adverse selection problems do not arise when individuals differ in their cost of care but all have the same accident probability.

5.3 Individualized Negligence Rule. The individualized standards of care are s_H^* and s_L^* for the high and low cost of care potential injurers. Informed individuals meet the relevant standard of care. As before, uninformed individuals are the source of the demand for insurance. The *ex ante* probability that an uninformed injurer will be found negligent is

$$\begin{aligned} \Pi(s) = \pi(s) & \quad \text{if } s < s_H^* \\ \theta_L \pi(s) & \quad \text{if } s_H^* \leq s < s_L^* \\ 0 & \quad \text{if } s_L^* \leq s \end{aligned} \quad (5.6)$$

Now consider the decision of an uninformed potential injurer to purchase insurance.

Proposition 7: Assume an individualized negligence standard, that insurers can either (1) verify an informed individual' cost type or (2) verify an individual's information status and that the uninformed purchase insurance. Then a necessary condition for (a) the uninformed to fully insure ($q = d$) and choose the level of care $\hat{s}_U = \operatorname{argmin} s + \theta_L \pi(s)d$, (b) $s_H^* < \hat{s}_U < s_L^*$ and (c) the value of information to be negative only is that

$$c_L s_L^* > c_L \hat{s}_U + \theta_L \pi(\hat{s}_U) d. \quad (5.7)$$

Proof: If insurers can verify an individual's cost type, they can verify information status, so it enough to consider that case where insurers can determine whether an individual is

informed. (a) This follows from the fact that the premium is actuarially fair. That $\Pi(\hat{s}_U)$ = $\theta_L \pi(\hat{s}_U)$ follows from part (b). (b) Evaluated at $q = d$, the first order condition for care is

$$\partial U_U / \partial s = -\theta_H u'(w_H)[c_H + \Pi'(\hat{s}_U)d] - \theta_L u'(w_L)[c_L + \Pi'(\hat{s}_U)d] = 0, \quad (5.8)$$

where $w_i = w - c_i \hat{s}_U - \Pi(\hat{s}_U)d$, $i = H, L$. Evaluated at $s \leq s_H^*$, $\partial U_U / \partial s > 0$, while evaluated at s_L^* , $\partial U_U / \partial s < 0$. (c) The value of information is

$$I_1 = \theta_H u(w - c_H s_H^*) + \theta_L u(w - c_L s_L^*) \quad (5.9)$$

$$- [\theta_H u(w - c_H \hat{s}_U - \theta_L \pi(\hat{s}_U)d) + \theta_L u(w - c_L \hat{s}_U - \theta_L \pi(\hat{s}_U)d)]$$

$$= \theta_H [u(w - c_H s_H^*) - u(w - c_H \hat{s}_U - \theta_L \pi(\hat{s}_U)d)] \quad (5.10)$$

$$+ \theta_L [u(w - c_L s_H^*) - u(w - c_L \hat{s}_U - \theta_L \pi(\hat{s}_U)d)]$$

The first term in (5.10) is always positive. If $I_1 < 0$, then the second term in (5.10) must be negative, which implies the inequality in (5.7) must hold. ||

Informed low cost types will want to masquerade as uninformed if it is less costly to insure than to meet their standard of care, that is, if the inequality in (5.7) holds. The self-selection constraint is

$$U_L(\Pi(s)q, q, s) \leq u(w - c_L s_L^*) \quad (5.11)$$

Suppose \tilde{q}_U is the level of coverage and \tilde{s}_U is the level of care, and let $\tilde{z} = (\Pi(\tilde{s}_U) \tilde{q}_U, \tilde{q}_U, \tilde{s}_U)$.

Proposition 8: Assume an individualized negligence standard, that insurers cannot verify whether individuals are uninformed and that the uninformed purchase insurance. Then a sufficient condition for (a) the uninformed to less than fully insure ($\tilde{q}_U < d$) and increase the level of care ($\tilde{s}_U > \hat{s}_U$) and (b) the value of information to be positive is that the self-selection constraint (5.11) is binding.

Proof: (a) This follows from the same argument as part (a) of Proposition 5. (b) The value of information is

$$\begin{aligned} I_2 &= \theta_H u(w - c_H s_H^*) + \theta_B u(w - c_L s_L^*) - [\theta_H U_H(\tilde{z}) + \theta_L U_L(\tilde{z})] \\ &= \theta_H [u(w - c_H s_H^*) - U_H(\tilde{z})] > 0 \end{aligned} \quad (5.12)$$

after substituting from the self-selection constraint. ||

Combining the results on the value of information from Propositions 7 and 8, we see that $I_1 < 0$ implies $I_2 > 0$. This result emphasizes the critical importance of the information disclosure environment, that is, insurers' ability or lack of ability to distinguish informed from uninformed potential injurers.

If the inequality in (5.7) does not hold, then a market for liability insurance will not develop. If insurers can determine information status, then $I_1 > 0$. But then individuals become informed and do not purchase insurance. If insurers cannot determine information status, then informed low costs individuals do not want to masquerade as uninformed. Then insurers know that only uninformed parties would want to buy insurance and there is no adverse selection problem. In this situation, the value of information is again $I_1 > 0$ and again there is no demand for insurance.

6. Conclusions

In this paper, we address the question of whether potential injurers' lack of information about the risks that they face is sufficient to create a demand for liability insurance under a negligence rule. That is, we assume the liability rule is the simple rule of negligence and that the negligence rule is perfectly enforced by the courts. We also assume that potential injurers, victims, and the courts are initially uninformed about

potential injurers' characteristics – either the risk of accidents or the cost of care. The issues are then (1) whether potential injurers will learn about their characteristics and (2) whether they will buy liability insurance.

The results of the analysis are summarized in Table 1. The Table is divided into four main cells according to the liability rule (uniform or individual) and potential injurers' unknown characteristic (risk type or cost type). Each main cell is further subdivided according to the information disclosure environment. Each of the resulting twelve cells describes the relevant Proposition, whether the value of information is positive or negative, which group purchases liability insurance and the main sufficient or necessary condition.

We find that whether potential injurers become informed and whether they buy liability insurance depends critically on whether a uniform or an individualized negligence rule is force. Under a uniform negligence rule, the same standard of care applies to all individuals (i.e., the “reasonable person” rule). As long as certain reasonable conditions are met, the value of information is positive under the uniform negligence rule. Thus, uninformed individuals choose to become informed about the risks they face and the outcome is the same as if individuals know their characteristics to begin with. The demand for insurance then comes from informed parties whose privately optimal level of care is below the negligence standard. For these individuals, the cost of being negligent and purchasing insurance is less than the cost of complying with the standard of care.

Under the individualized negligence rule, the standard of care depends on the individual's characteristics, either their risk-type or their cost-type. If there is a demand

for liability insurance, it is by uninformed parties who use liability insurance to hedge the “classification risk.” Whether individuals choose to become informed or not depends critically on the information disclosure environment. In order for a market for liability insurance to develop, insurance companies must be able to determine whether individuals are informed or uninformed. This would seem to require a perfectly enforced mandatory disclosure rule. Otherwise, informed bad risks may masquerade as uninformed potential injurers creating an adverse selection problem. If this occurs, then the value of information is positive, informed good and bad risks meet the relevant standard of care and do not demand liability insurance.

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Figure 1 Timing of the Model

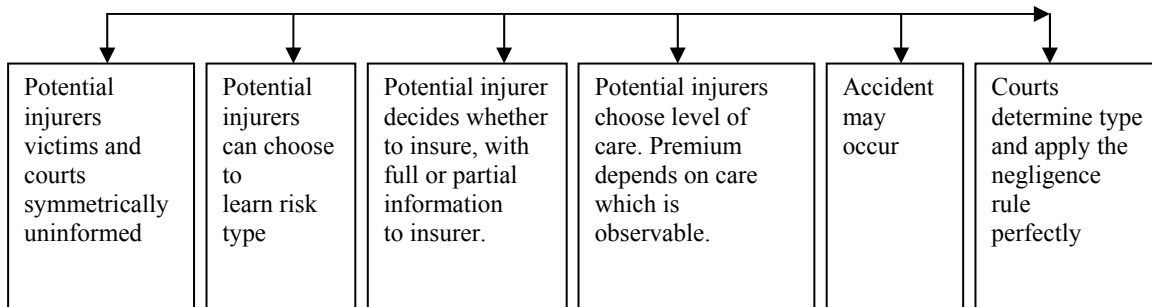


Table 1. Summary of Main Results

		Negligence Rule					
		Uniform			Individual		
		Disclosure Environment			Disclosure Environment		
		Type	Status	None	Type	Status	None
Risk Type Unknown	Result	Prop. 1	Prop. 2	Prop. 3	Prop. 4	Prop. 4	Prop. 5
	Value of Information	Positive	Positive	Positive	Negative	Negative	Positive
	Ins. Buyer	Informed Good Risk	Informed Good Risk	Informed Good Risk	Uninformed	Uninformed	None
	Condition	A	B	B	C	C	B
Cost Type Unknown	Result	Prop. 6	Prop. 6	Prop. 6	Prop. 7	Prop. 7	Prop. 8
	Value of Information	Positive	Positive	Positive	Negative	Negative	Positive
	Ins. Buyer	Informed High Cost	Informed High Cost	Informed High Cost	Uninformed	Uninformed	None
	Condition	D	D	D	E	E	B

Conditions:

- A. The necessary and sufficient condition is $x_U^* \geq x_G^* + \pi_G(x_G^*)d$.
- B. The sufficient condition is that the self-selection constrain is binding.
- C. The sufficient condition is $\theta_G x_G^* + \theta_B x_B^* \geq \hat{x}_U + \theta_B \pi_B(\hat{x}_U)d$.
- D. The necessary and sufficient condition is $c_{HSU}^* \geq c_{HSH}^* + \pi(s_H^*)d$.
- E. The necessary condition is $c_{LSL}^* > c_L \hat{s}_U + \theta_L \pi(\hat{s}_U)d$.