SECRECY AND SAFETY

by

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ABSTRACT

We employ a simple two-period model to show that the use of confidential settlement as a strategy for a firm facing tort litigation leads to lower average product safety than that which would be produced if a firm were committed to openness. Moreover, confidentiality can even lead to declining average product safety over time. We also show that a rational risk-neutral consumer's response to a market environment, wherein a firm engages in confidential settlement agreements, may be to reduce demand. We discuss how firm profitability is influenced by the decision to have open or confidential settlements; all else equal, a firm following a policy of openness will pay higher equilibrium wages and incur higher training costs, though product demand will not be diminished (as it may be for a firm employing confidentiality). Further, we characterize the choice of regime, providing conditions such that, if the cost of credible auditing (to verify openness) is low enough, a firm will choose to pay for auditing and eschew confidentiality.

1. Introduction

What is the effect of secrecy about the existence or extent of product-generated harms on the provision of safe products? Such secrecy naturally arises when firms negotiate and settle lawsuits (filed by harmed product users) with "sealing" orders provided by courts, or private "contracts of silence," that keep everything from initial discovery through the actual details of a settlement secret, under pain of court-enforced contempt citations or damages for breach of contract, respectively.[1] According to attorneys, these practices are widespread and routine in products liability cases.[2] Recent revelations of the past sexual abuse of minors by priests, much of which was concealed by confidential settlements, make clear that this practice is not confined to product markets alone.[3]

In this paper we employ a simple two-period model to show that the use of secrecy in product markets turns out to have potentially significant (negative) effects on the average quality of inputs used, on the standards set for seeking to improve input quality, on the average safety of products sold, and on the resulting volume of trade. More precisely, we show that the use of confidential settlement as a strategy for a firm facing tort litigation leads to lower average product safety than that which would be produced if a firm were committed to openness. Moreover, confidentiality can even lead to declining average product safety over time. We also show that a rational risk-neutral consumer's response to a market environment, wherein a firm engages in confidential settlement agreements, may be to reduce demand. Finally, we discuss how firm profitability is influenced by the decision to have open or confidential settlements; all else equal, a firm following a policy of openness will pay higher equilibrium wages and incur higher training costs, though product demand will not be diminished (as it may be for a firm employing confidentiality). Moreover, an open firm may face costs of making the commitment to openness credible, though this depends upon the law.[4]

The extensive provision of secrecy by courts is becoming, both for the states and the federal government, an important policy issue. For some time, approximately one-fifth of the states (and the federal government) have been considering eliminating or severely restricting confidentiality, though the focus of such "sunshine" laws tends to be only about conditions that significantly endanger public health and safety (leaving much of products liability untouched). Recently all federal judges in one state (South Carolina) agreed that they would no longer provide confidentiality in "everything from products liability cases to child-molestation claims and medical malpractice suits."[5] In April, 2003, legislation was introduced into the U.S. Senate (S.819) to modify the U.S. Code so as to restrict the use of protective orders and the sealing of cases.

It is not surprising that the legal literature on confidentiality is quite large; for a discussion of some of the (conflicting) legal issues, see Miller (1991), Doggett and Mucchetti (1991), Garfield (1998), Dore (1999) and Fromm (2001). There are basically three arguments made by those desiring elimination of confidentiality and three arguments made by those in favor of continuing to allow confidentiality. Those favoring eliminating confidentiality stress the benefits to third parties: 1) other injured people who have not realized they may have a cause of action (both consumers who bought the product and were harmed, as well as non-consumers harmed by externalities, such as occur in second-hand smoke or toxic chemical spills) will realize that they have a case; 2) further risks to health and safety will be averted; and 3) discovery sharing among plaintiffs harmed by the same product (which might improve the viability of plaintiffs' cases, or at least reduce the costs associated with pursuing a suit) will be facilitated.[6] Those favoring continuing to allow confidential settlements argue that: 4) discovery sharing is likely to inspire nuisance suits; 5) important privacy interests of the parties (such as protecting trade secrets or highly personal information) will be

violated; and 6) many settlements are made contingent upon sealing (promoting settlement is an important goal of the civil justice system; see Federal Rule of Civil Procedure 16(a), Yeazell, 1996).

Related Literature

This paper naturally fits into (and bridges) two literatures, namely that concerned with signaling product quality via price, and that concerned with confidentiality and bargaining. Previous papers in which monopolies signal quality via price include Bagwell and Riordan (1991), Bagwell (1992) and Daughety and Reinganum (1995).[7] This paper abstracts from competitive considerations such as entry or the presence of other firms, as well as advertising and other non-price avenues for signaling, but expands the quality signaling model to consider a continuum type-space which is endogenously determined by the firm's decision to retain or replace an input. It is closest to Daughety and Reinganum (1995), since (as there) the post-market-transaction continuation game reflects the firm's liability for harms due to its choices regarding safety provision.

The economics literature concerned with confidentiality and bargaining is much smaller. Yang (1996) briefly discusses exogenously-determined regimes of confidentiality or openness and their effect on sequential bargaining by a defendant with a series of plaintiffs. Daughety and Reinganum (1999, 2002) also consider a sequence of settlement bargaining games, but model bargaining as being over both money and the choice of confidentiality versus openness. Using an asymmetric information bargaining model, they show that allowing such secrecy encourages settlement, although confidential settlements will involve higher average amounts. Noe and Wang (forthcoming) provide a model of confidentiality in sequential negotiations which is different from those in the confidential settlement literature. They show that, in the context of a buyer facing a sequence of sellers, when the items to be purchased are sufficiently complementary, it is profitable

for the buyer to randomize the order in which he approaches the sellers, and to keep secret this order and the outcome of previous negotiations.

None of the above analyses connects liability and the presence or absence of confidentiality to the endogenous determination of product safety, which we do here. In particular, we show that commitment to a particular informational regime (confidentiality versus openness) influences a firm's downstream incentives to improve safety and a consumer's willingness to purchase the product. We also characterize the choice of regime, providing conditions such that, if the cost of credible auditing (to verify openness) is low enough, a firm will choose to pay for the auditing and eschew confidentiality. Moreover, this means that if society were to ban (or substantially limit) the use of confidential settlements, then under the relevant conditions, a firm would prefer this (as the cost of credible auditing would then be zero). However, there are also conditions under which even free auditing would not make a firm prefer openness, in which case it would prefer that the law allow confidential agreements.

Plan of the Paper

In Section 2 the model set-up, structure and notation is detailed. In Section 3 we characterize the equilibrium under the two regimes of openness and confidentiality, while Section 4 compares the equilibria for the two regimes. Section 5 examines the endogenous choice of regime. The analysis of these sections is under a parametric restriction that guarantees the existence of a (unique) revealing equilibrium. Section 6 considers the complementary parametric restriction and shows that only a pooling equilibrium exists; it then provides the results analogous to those in the earlier sections. Section 7 provides a summary of results and a discussion of the policy implications of banning or allowing confidentiality. Technical derivations and proofs are provided in appendices.

2. Model Set-Up, Structure and Notation

We consider a two-period model of a firm producing a product with a safety attribute. Within each period, three distinct interactions occur. First, a firm chooses an input whose quality affects the safety of its product. Second, the firm chooses a price, which affects the purchasing decisions of consumers. Third, the firm engages in settlement negotiations with consumers who are harmed by the product. Prior to the start of Period 1, we assume that the firm has an opportunity to choose the regime under which it will conduct its settlement negotiations: the settlements are confidential (denoted C) unless the firm has committed itself to a regime of openness (denoted O). Commitment to a regime of openness will require a fixed expenditure on external monitoring.

We describe each of these interactions, and the linkages between them both within and across periods, in turn. We begin by defining some notation that will be common to the two periods, and then we specify the timing and the information structure of the model. We will indicate parameters which are assumed to vary with the regime by a superscript "i," where i = O or C.

Notation

Let θ denote the quality of a worker or, alternatively, a technology. We also identify θ with the safety of a unit of the product produced by this worker (or technology). We interpret θ as the probability that the consumer uses the product without incident; that is, θ is the probability that the product does not cause harm. Thus, safer products are associated with higher values of θ. We will also typically refer to θ as (interchangeably) the worker's, the firm's or the product's "type." We assume that θ is distributed according to a continuously differentiable distribution function, $G(\bullet)$, with positive density, $g(\bullet)$, on the interval $[\underline{\theta}, \bar{\theta}]$. Let $\mu \equiv E(\theta)$ denote the expected value of θ.

We further assume that the worker can also engage in alternative activities for the firm,

should he not be fully-employed in producing the product. This alternative activity may generate a second product or revenue stream for the firm, but it need not; rather, it may contribute to the on-going functioning of the firm. In this alternative employment, the worker generates profits for the firm that are proportional (at a rate denoted β) to his quality.[8] We will maintain the assumption that the firm makes more profit when the worker produces the firm's primary product than when he is engaged in these alternative activities, so the worker will only engage in alternative employment within the firm when consumer demand falls short of his capacity, which we denote by N. Finally, we assume that a worker receives a wage of w_n^i if newly-hired, while a worker who has been retained from a previous period receives a wage of w_r^i. For the moment, we treat these wages as parameters; later we will describe how they are determined endogenously within the model. Each new worker hired must also be trained by the firm, at a cost denoted t. For simplicity, we assume there are no other costs associated with producing the product.

Let V denote the value of consumption of one unit of the product. We assume that there are N consumers (so the worker has the capacity to serve the entire market), and that each consumer demands at most one unit. Let the prevailing price for period j be denoted p_j, for $j = 1, 2$. In order to determine her willingness to pay for the product, the consumer must form expectations (or beliefs, depending upon the information available to her) about the likelihood that she will be harmed by the product, and the associated losses she will bear.

In order to focus on other issues, we assume a simple litigation subgame structure. In particular, suppose that it is common knowledge that each harmed consumer (each plaintiff, denoted P) suffers an injury in the amount δ.[9] Under the assumption that the firm (the defendant, denoted D) is strictly liable for the harms it causes, this is the amount of damages P would receive if

successful at trial. However, merely knowing that one has been harmed by use of a product is not sufficient to be successful at trial; rather, convincing evidence of causation is required, even under strict liability. We assume that there is a probability, denoted λ^i, that a consumer will be able to provide convincing evidence. With the complementary probability, other intervening factors may cloud the relationship between product use and harm, undermining the viability of the consumer's case. We index the likelihood of a viable case by the regime to indicate that confidential versus open settlement may affect the likelihood that a case is viable. In particular, we assume that $\lambda^C \leq \lambda^O$; that is, one effect of confidential settlement (which usually results in a blanket gag order) is that it prevents plaintiffs from learning about each other's cases and possibly sharing information that might improve the viability of their cases (see Hare, et. al., 1988; they argue that this is an important reason for defendants to seek confidentiality). Moreover, we assume that when a consumer complains of harm to the firm, it is common knowledge (between the parties) whether the consumer's case is viable or not. Thus, plaintiffs with non-viable cases receive nothing, while plaintiffs with viable cases receive a settlement. We assume that the amount of the settlement is provided by finding the Nash Bargaining Solution to a complete information game, taking into account the parties' relevant costs of settlement versus trial.[10]

Let k_{SP} and k_{SD} denote the costs of negotiating a settlement, for P and D, respectively, and let k_{TP} and k_{TD} denote the incremental costs of trial, for P and D, respectively. Since most product liability suits involve a plaintiff's attorney being paid a contingency fee,[11] k_{SP} is actually likely to be substantial (from 1/4 to 1/3 of the settlement P receives), while the incremental costs of trial, k_{TP}, may be relatively small. On the other hand, since the defendant is likely to pay his attorney an hourly fee, k_{SD} may be relatively small compared to the incremental cost of trial, k_{TD}. The model,

however, allows these costs to take on arbitrary values.

<u>Timing and Information Structure</u>

Prior to the first period, the firm commits itself to a regime of either open, or confidential, settlement negotiations. A commitment to a regime of openness will require a public expenditure on independent monitoring; failure to make such a costly and visible commitment results in an inference that the firm will engage in confidential settlement.

At the beginning of Period 1, the firm hires a worker by offering a contract specifying a wage for Period 1 (w_n^i) and a wage for Period 2 (w_r^i), if the worker is retained. The firm reserves the option to replace the worker in Period 2, so the contract must (in equilibrium) reflect the worker's risk of being fired. The firm also incurs a training cost, denoted t.[12] We assume that the realized value of θ associated with this worker is not observed by the firm until after the product has been sold and consumers begin reporting harm. Thus the firm sets its price p_1 under symmetric, but imperfect, information vis-a-vis the consumer. Consumers make their purchase decisions, and some suffer harm. We assume that all consumers report their harms to the firm, seeking compensation, but only those with viable suits receive settlements. At this point, since harmed consumers are not aware of the totality of the complaints, only the firm is able to construct the realized value of θ.

At the beginning of Period 2, it is now common knowledge that the firm knows the safety of its own product. If the firm is credibly committed to a policy of openness, then consumers can costlessly ascertain the firm's realized first period value of θ. Furthermore, independent of its policy of openness or confidentiality, if the firm chooses to replace its worker (or its technology) with a new one, we assume that this is observable to consumers. If the worker is replaced, then Period 2 plays out the same as Period 1. If the firm chooses to retain its worker (or its technology), then

under a regime of openness, consumers also know the product's second-period safety. However, under a regime of confidentiality, since the consumer is uninformed about the product's continuing level of safety, she is at an informational disadvantage compared to the firm, and takes this into account in her subsequent purchasing behavior. In particular, she draws an inference about product safety from the price p_2 and bases her purchasing decision on this inference. As in Period 1, consumers harmed in Period 2 seek compensation and those with viable cases receive a settlement.

3. Analysis of the Model under Alternative Regimes

We solve the model by backward induction. We first characterize the settlement subgame equilibrium, which is the same for both periods. We then briefly discuss the alternative uses of the worker within the firm. Then we characterize equilibrium play in Period 2, and then in Period 1, first under the assumption of an open regime and then under a regime of confidentiality.

Settlement Subgame Equilibrium

By negotiating and settling rather than going to trial, P (respectively, D) individually spends the amount k_{SP} (respectively, k_{SD}), but they jointly save the amount $K_T \equiv k_{TP} + k_{TD}$. Thus, the resulting Nash Bargaining Solution involves the plaintiff with a viable case receiving her disagreement payoff, $\delta - k_{SP} - k_{TP}$, plus one-half of the saved incremental trial costs. Therefore, the plaintiff receives $\delta - k_{SP} - k_{TP} + K_T/2$. Similarly, the defendant pays his disagreement payoff,[13] less one-half of the saved incremental trial costs, for a resulting payment of $\delta + k_{SD} + k_{TD} - K_T/2$.

Since not all cases are viable, we compute the continuation payoffs for the consumer and the firm, conditional upon the consumer being harmed. A harmed consumer will suffer a loss of δ and receive a settlement of $\delta - k_{SP} - k_{TP} + K_T/2$ if she has a viable case, which occurs with probability λ^i in regime i. Thus, the expected loss borne by a harmed consumer in regime i, denoted L_P^i, is given

by $L_P^i = \delta - \lambda^i(\delta - k_{SP} - k_{TP} + K_T/2)$. Similarly, the expected loss borne by the firm when a consumer is harmed in regime i, denoted L_D^i, is given by $L_D^i = \lambda^i(\delta + k_{SD} + k_{TD} - K_T/2)$. We assume that each party bears some loss; that is, $L_P^i > 0$ and $L_D^i > 0$. For simplicity, let L^i denote the combined loss due to consumer harm and settlement costs: $L^i \equiv L_P^i + L_D^i = \delta + \lambda^i K_S$, where $K_S \equiv k_{SP} + k_{SD}$.

Alternative Uses of the Worker

Recall that the worker can either produce the product with the safety attribute, or engage in alternative productive activities for the firm. The social value of using a worker of type θ to produce a unit of the product is given by $V - (1 - \theta)L^i$, while the social (and private) value of using the worker in alternative activities is given by $\beta\theta$. We make the following assumption regarding the relative values of these alternatives.

Assumption 1. For i = O, C, (a) $V - (1 - \theta)L^i - \beta\theta > 0$ for all $\theta \in [\underline{\theta}, \bar{\theta}]$; (b) $V > L^i > \beta$.

Part (a) implies that employing the worker in producing the product is always more valuable (socially) than using him in alternative activities. Note that $V - (1 - \theta)L^i - \beta\theta$ is the net social value of using a worker of type θ to produce one unit of the product. Part (b) implies that this net social value is increasing in the safety of the product (since $L^i > \beta$), and the product is socially valuable (since $V > L^i$). We will assume that $\beta > L_D^C$; the alternative case will be taken up in Section 6.

Notice that, because each consumer has unit demand and the firm is a monopolist, the firm will be able to extract the full value of the product to the consumer as long as there is symmetric information about θ. Thus, in the case of a newly-hired worker (when neither the firm nor the consumer knows θ), all consumers will want a unit of the product at the symmetric-information monopoly price, and the worker's entire capacity will be devoted to producing the product. In addition, in a regime of openness, the consumer and the firm will both know the retained worker's

quality. Thus, all consumers will want a unit of the product at the full-information monopoly price and again the worker's entire capacity will be devoted to producing the product. Only in the case of a confidential regime, in which asymmetric information prevails, might the worker spend a portion of his capacity on alternative activities.

Equilibrium in a Regime of Openness

We solve the model by backward induction, first characterizing the equilibrium in Period 2 and then in Period 1. Let θ_j denote the quality of the worker in Period j, j = 1, 2. If the worker has been retained from Period 1, then it is common knowledge (under an O regime) that $\theta_2 = \theta_1$. In this case, the consumer's maximum willingness to pay for the good is given by $V - (1 - \theta_1)L_P^O$. Thus, the firm will charge $p_2 = V - (1 - \theta_1)L_P^O$ and each consumer will buy one unit. In this case, since the worker's capacity is exhausted by the demand for the firm's product, no effort will be devoted by the worker to the alternative use. Thus, the firm's continuation profit from retaining a worker of type θ_1, denoted $\Pi_2^O(r; \theta_1)$, is given by: $\Pi_2^O(r; \theta_1) \equiv N[V - (1 - \theta_1)L_P^O - (1 - \theta_1)L_D^O] - w_r^O = N[V - (1 - \theta_1)L^O] - w_r^O$. Notice that, because the consumer adjusts her willingness to pay to account for her potential downstream losses, the firm faces the full loss L^O.

If the worker has been replaced, then it is common knowledge that neither the firm nor the consumer knows the true value of θ_2. In this case, the consumer's maximum willingness to pay for the good is $V - (1 - \mu)L_P^O$. The firm will set $p_2 = V - (1 - \mu)L_P^O$ and each consumer will buy one unit. The firm's continuation profit from hiring a new worker, denoted $\Pi_2^O(n)$, is given by: $\Pi_2^O(n) \equiv N[V - (1 - \mu)L_P^O - (1 - \mu)L_D^O] - w_n^O - t = N[V - (1 - \mu)L^O] - w_n^O - t$.

In making its retention decision at the beginning of Period 2, the firm compares $\Pi_2^O(r; \theta_1)$ to $\Pi_2^O(n)$, and retains the worker whenever $\Pi_2^O(r; \theta_1) \geq \Pi_2^O(n)$; that is, whenever:

$$\theta_1 \geq \theta^O \equiv \mu - (w_n^O + t - w_r^O)/NL^O. \tag{1}$$

Given this retention rule, the firm's expected continuation profits from the beginning of Period 2 is:

$$E\Pi_2^O \equiv \Pi_2^O(n)G(\theta^O) + \int^O \Pi_2^O(r; \theta_1)g(\theta_1)d\theta_1$$

$$= \{N[V - (1 - \mu)L^O] - w_n^O - t\}G(\theta^O) + \int^O \{N[V - (1 - \theta_1)L^O] - w_r^O\}g(\theta_1)d\theta_1, \tag{2}$$

where $\int^O$ indicates that the domain of integration is $[\theta^O, \bar{\theta}]$.

The analysis of Period 1 is quite straightforward, since this period looks exactly like Period 2 when the worker has been replaced. In Period 1, it is common knowledge that neither the firm nor the consumer knows the true value of θ_1. The consumer's maximum willingness to pay for the good is $V - (1 - \mu)L_P^O$, so $p_1 = V - (1 - \mu)L_P^O$ and each consumer will buy one unit. The firm does not have a retention choice as it is hiring the worker for the first time. Thus, the firm's profit from Period 1 on (that is, the two-period profit under the O regime, gross of any monitoring costs it must pay to credibly commit to O), denoted Π_1^O, is given by:

$$\Pi_1^O \equiv N[V - (1 - \mu)L^O] - w_n^O - t + E\Pi_2^O$$

$$= \{N[V - (1 - \mu)L^O] - w_n^O - t\}(1 + G(\theta^O)) + \int^O \{N[V - (1 - \theta_1)L^O] - w_r^O\}g(\theta_1)d\theta_1. \tag{3}$$

<u>Equilibrium in a Regime of Confidentiality</u>

Again, we begin with Period 2. In what follows, we sketch the derivation of a revealing perfect Bayesian equilibrium; a formal statement and proof are provided in Appendix A. Recall that in a regime of confidentiality, information regarding Period 1 suits is not observable to consumers in Period 2, as it has been suppressed through the use of confidentiality agreements.[14] Thus, if the worker has been retained from Period 1, Period 2 consumers need to form beliefs about the product's safety based on choices made by the firm that are observable to Period 2 consumers. These choices are (1) the firm's decision to retain the worker, and (2) the firm's choice of price for Period 2.

We assume that, upon observing that the firm has retained the worker from Period 1, consumers believe that the worker's type belongs to an interval $[\Theta, \bar{\theta}]$; that is, the marginally-retained worker is of type Θ. Thus, consumers believe that the firm would have retained the worker if his quality were sufficiently high. Moreover, upon observing that the firm is charging p_2, consumers believe that the worker's type is $b(p_2; \Theta)$. Since we will be characterizing a revealing equilibrium, we employ "point beliefs" by specifying that b is a singleton rather than a set. In a revealing equilibrium, the beliefs $b(\bullet; \Theta)$ will be correct, as will the conjectured value of Θ.

Since each firm would be tempted to inflate its price (if the consumer were to purchase a unit for sure at every price), the consumer must respond to higher prices with increasing "wariness." Indeed, the consumer must confront higher prices with a lower probability of concluding a sale. Let $s(p_2; \Theta)$ denote the probability of a sale when the firm charges p_2, given the conjectured value of Θ. Then the firm's continuation payoff from retaining a worker of type θ_1, denoted $\Pi_2^C(r; \theta_1, \Theta)$, is:

$$\Pi_2^C(r; \theta_1, \Theta) \equiv \max_{p_2} \ Ns(p_2; \Theta)[p_2 - (1 - \theta_1)L_D^C] + N(1 - s(p_2; \Theta))\beta\theta_1 - w_r^O. \tag{4}$$

Notice that the worker spends $Ns(p_2; \Theta)$ units of his capacity on producing the product, and the remaining $N(1 - s(p_2; \Theta))$ units of his capacity on the alternative activity, where each capacity unit yields a payoff of $\beta\theta_1$. Throughout the remainder of this section and Sections 4 and 5, we will assume that $\beta > L_D^C$, and we will characterize a revealing perfect Bayesian equilibrium (see Appendix A for a formal definition, statement and proof).[15] The alternative case, wherein $\beta < L_D^C$ and only a pooling equilibrium exists, will be taken up in Section 6.

The first-order-condition for the firm's problem is:

$$s'[p_2 - (1 - \theta_1)L_D^C - \beta\theta_1] + s = 0, \tag{5}$$

where s' denotes the derivative of $s(p_2; \Theta)$ with respect to p_2.

A consumer (who must randomize in a revealing equilibrium) will only be willing to randomize if she is indifferent about buying; that is, if $V - (1 - b(p_2; \Theta))L_P^C - p_2 = 0$. Thus, the revealing equilibrium price must be $p_2 = p_2^*(\theta_1) \equiv V - (1 - \theta_1)L_P^C$. In order to convert equation (5) to a differential equation in p_2, we can solve for θ_1 as a function of p_2 to obtain $\theta_1 = (L_P^C - V + p_2)/L_P^C$. Substituting this result into equation (5) yields an ordinary differential equation for $s(p_2; \Theta)$.

$$s'[p_2(L^C - \beta) + \beta V - \beta L_P^C - VL_D^C] + sL_P^C = 0. \tag{6}$$

We also need a boundary condition to select among the family of solutions to the ordinary differential equation (6). Since the consumer believes that Θ is the worst type that would have been retained, the appropriate boundary condition is $s(p_2^*(\Theta); \Theta) = 1$, where $p_2^*(\Theta) = V - (1 - \Theta)L_P^C$. This follows since, as the (inferred) worst type, there is no need for Θ to suffer a signaling cost. The solution to the ordinary differential equation (6) through this boundary condition is given by:

$$s(p_2; \Theta) = \{[p_2^*(\Theta)(L^C - \beta) + \beta V - \beta L_P^C - VL_D^C]/[p_2(L^C - \beta) + \beta V - \beta L_P^C - VL_D^C]\}^\alpha, \tag{7}$$

where $\alpha \equiv L_P^C/(L^C - \beta) > 1$ under our maintained assumption that $\beta > L_D^C$. It can be shown that the function $s(p_2; \Theta)$ is declining and convex in p_2. Upon substituting the firm's optimal price function $p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$ into equation (7) and simplifying, we can write the equilibrium probability of a sale as a function of the firm's type. Let $s^*(\theta_1; \Theta) \equiv s(p_2^*(\theta_1); \Theta)$; then:

$$s^*(\theta_1; \Theta) = \{[V - (1 - \Theta)L^C - \beta\Theta)]/[V - (1 - \theta_1)L^C - \beta\theta_1)]\}^\alpha. \tag{8}$$

Observe what $s^*(\theta_1; \Theta)$ entails. First, consider the ratio inside the braces. The numerator is the net social value associated with one unit produced by the marginally-retained type of worker; this is also the net unit profit for the firm's product (since welfare and profit are the same for this unit-demand analysis). Likewise, the denominator is the net unit profit for the firm's product for a retained worker of type $\theta_1 > \Theta$. Thus, this ratio is a fraction, the purpose of which is to reduce the incentive

for mimicry of high-type firms by low-type firms. However, what the analysis tells us is that this degree of wariness by the consumer is not sufficient to deter mimicry. The exponent, α, which is $L_P^C/(L^C - \beta)$, reflects both the losses borne by the consumer (and greater losses should make her more wary) as well as the degree of sensitivity of the firm to the consumer's means for responding to price increases. Higher β means that the firm's alternative use of the worker is proportionally more profitable, making the loss of a sale in response to a price increase less costly. Recognizing this means that the consumer must be yet more wary. This is why α, which is greater than one, further amplifies the effect of the ratio inside the braces, so as to further deter mimicry. Since this is the unique revealing equilibrium, the resulting response by the consumer is both necessary and sufficient to achieve revelation in equilibrium. As will be seen in Section 6, if β is too low ($\beta < L_D^C$), then higher types of the firm will be overly-sensitive to the loss of sales due to a price increase (which would reveal their higher safety), and pooling will result.

We can re-write the firm's continuation profits as:

$$\Pi_2^C(r; \theta_1, \Theta) = Ns^*(\theta_1; \Theta)[p_2^*(\theta_1) - (1 - \theta_1)L_D^C] + N[1 - s^*(\theta_1; \Theta)]\beta\theta_1 - w_r^O$$
$$= Ns^*(\theta_1; \Theta)[V - (1 - \theta_1)L^C - \beta\theta_1] + N\beta\theta_1 - w_r^O,$$

where $s^*(\theta_1; \Theta)$ is as given in equation (8). Differentiating the firm's equilibrium profits with respect to θ_1 indicates that equilibrium profits are increasing in θ_1; that is, firms with safer products (equivalently, higher-quality workers) make higher profits, despite the fact that they face demand withdrawal from wary consumers.

Since firm profits are increasing in type, the form of the consumer's beliefs about retention is confirmed: firms with higher-quality workers will retain them, while firms with sufficiently low-quality workers will replace them. If the worker was replaced rather than retained, then it is

common knowledge that neither the firm nor the consumer knows the true value of θ_2. Analogously to this case in the O regime, the consumer's maximum willingness to pay for the good is $V - (1 - \mu)L_P^C$, the firm sets $p_2 = V - (1 - \mu)L_P^C$ and each consumer buys one unit. The firm's continuation profit from hiring a new worker, denoted $\Pi_2^C(n)$, is: $\Pi_2^C(n) \equiv N[V - (1 - \mu)L^C] - w_n^C - t$.

To determine the identity of the worst worker retained, we need to find θ^C such that $\Pi_2^C(r; \theta^C, \theta^C) = \Pi_2^C(n)$. That is, if the consumer conjectures that θ^C is the worst type of worker retained, then the firm must be indifferent between retaining and replacing that type. Since $s(p_2^*(\theta^C); \theta^C) = 1$, $\Pi_2^C(r; \theta^C, \theta^C) = N[p_2^*(\theta^C) - (1 - \theta^C)L_D^C] - w_r^O = N[V - (1 - \theta^C)L_P^C - (1 - \theta^C)L_D^C] - w_r^O = N[V - (1 - \theta^C)L^C] - w_r^O$. Setting this equal to $\Pi_2^C(n)$ and solving for θ^C yields:

$$\theta^C \equiv \mu - (w_n^C + t - w_r^C)/NL^C. \tag{9}$$

Thus, under a confidential regime, the firm retains the worker if $\theta_1 \geq \theta^C$, and otherwise replaces him.

Upon substituting $\Theta = \theta^C$ into equation (8), we can finally write the reduced-form equilibrium probability of a sale as a function of worker type θ_1 as follows:

$$s^*(\theta_1; \theta^C) = \{[V - (1 - \theta^C)L^C - \beta\theta^C]/[V - (1 - \theta_1)L^C - \beta\theta_1]\}^\alpha. \tag{10}$$

The following proposition (which is proved in Appendix B) summarizes the impact of several parameters on the equilibrium probability of a sale.

Proposition 1. The equilibrium probability of a sale is decreasing and convex in its argument θ_1. In addition, the equilibrium probability of a sale increases with an increase in the parameters V, N and μ, or with a decrease in the parameters β and t.

The parameters V and β enter s^* directly; an increase in V makes the consumer less wary while (as discussed earlier) an increase in β increases the incentive for low types to mimic high types, thereby increasing the consumer's wariness. N, μ and t enter indirectly via θ^C; since consumers are less

wary when θ^C is higher, increases in N and μ increase s* while increases in t reduce s*. Revealing equilibria do not normally depend on the distribution function (here, G), but only on the support (here, $[\underline{\theta}, \bar{\theta}]$). However, in this case the consumer's beliefs about the support have been updated (i.e., the type space is determined endogenously in this model), and the resulting probability of sale function $s*(\theta_1; \theta^C)$ now depends on other attributes of the distribution (here, μ) through θ^C.

Given the retention rule and the equilibrium strategies $p_2*(\theta_1)$ and $s*(\theta_1; \theta^C)$, we can write the firm's expected continuation profits from the beginning of Period 2 as:

$$E\Pi_2^C \equiv \Pi_2^C(n)G(\theta^C) + \int^C \Pi_2^C(r; \theta_1, \theta^C)g(\theta_1)d\theta_1$$

$$= \{N[V - (1 - \mu)L^C] - w_n^C - t\}G(\theta^C)$$

$$+ \int^C \{Ns*(\theta_1; \theta^C)[V - (1 - \theta_1)L^C] + N[1 - s*(\theta_1; \theta^C)]\beta\theta_1 - w_r^C\}g(\theta_1)d\theta_1, \qquad (11)$$

where $\int^C$ indicates that the domain of integration is $[\theta^C, \bar{\theta}]$.

Again, the analysis of Period 1 is quite straightforward, since this period looks exactly like Period 2 when the worker has been replaced. In Period 1, it is common knowledge that neither the firm nor the consumer knows the true value of θ_1. The consumer's maximum willingness to pay for the good is $V - (1 - \mu)L_P^C$, so $p_1 = V - (1 - \mu)L_P^C$ and each consumer will buy one unit. The firm does not have a retention choice as it is hiring the worker for the first time. Thus, the firm's profit from Period 1 on (in the C regime), denoted Π_1^C, is given by:

$$\Pi_1^C \equiv N[V - (1 - \mu)L^C] - w_n^C - t + E\Pi_2^C$$

$$= \{N[V - (1 - \mu)L^C] - w_n^C - t\}(1 + G(\theta^C))$$

$$+ \int^C \{Ns*(\theta_1; \theta^C)[V - (1 - \theta_1)L^C] + N[1 - s*(\theta_1; \theta^C)]\beta\theta_1 - w_r^C\}g(\theta_1)d\theta_1. \qquad (12)$$

4. Comparison of the Regimes

In this section, we first determine the equilibrium wages associated with the O and C

regimes. We then compare the O and C regimes' *ex ante* performance in terms of the average quality of labor in Period 2, the average safety of products sold in Period 2, the average volume of trade in Period 2, and the time path of the average safety of products sold.

Equilibrium Wages

Since ours is a two-period model, we assume that the firm and its workers live for two periods. In Period 1, the firm offers a randomly-drawn worker a two-period contract which specifies the wage in Period 1 and the wage in Period 2, should the worker be retained.[16] For simplicity, we assume that the wage is the same in both periods. Nevertheless, the wage must reflect the chance that the worker will not be retained. If we assume that the worker has an outside alternative involving certain employment for both periods at the wage w_a, and that a worker fired in Period 1 can only obtain a wage of $\underline{w} < w_a$ in Period 2, then the wage under regime i must satisfy $w^i + w^i(1 - G(\theta^i)) + \underline{w}G(\theta^i) = 2w_a$; that is:

$$w^i = w^*(\theta^i) \equiv [2w_a - \underline{w}G(\theta^i)]/[2 - G(\theta^i))]. \tag{13}$$

Notice that $w^{*\prime}(\theta^i) > 0$; that is, a firm that sets a higher retention threshold must offer a higher wage (since the worker is less likely to be retained).

Since our model allows the firm to replace a worker in Period 2, a modeling issue arises regarding the wage to be offered to a new worker in the second period (since the model ends after the second period). We continue under the assumption that this worker must be offered the same wage as determined in equation (13). This assumption makes the determination of the retention thresholds particularly simple, facilitates computational results, and maintains comparability with the alternative interpretation of the input as a technology.

Recall that the retention threshold in regime i is given by $\theta^i \equiv \mu - (w_n^i + t - w_r^i)/NL^i$. Under

our maintained assumption that a new second-period worker receives the same wage as was offered

to the worker hired in the first period, $w_n^i = w_r^i = w^*(\theta^i)$. Thus, the retention threshold[17] reduces to

$\theta^i = \mu - t/NL^i$, which (from the derivation of L^i) also means that $\theta^i = \mu - t/N(\delta + \lambda^i K_S)$. The

following proposition summarizes the effect of confidentiality on worker retention and wages.

> Proposition 2. (a) $\theta^C < (=) \theta^O$ as $\lambda^C < (=) \lambda^O$. That is, the retention threshold for workers
>
> is lower in a confidential regime. (b) $w^*(\theta^C) < (=) w^*(\theta^O)$ as $\lambda^C < (=) \lambda^O$. That is, the firm
>
> pays lower wages (since it fires the worker less often) in a confidential regime.

Equilibrium Worker Quality and Product Safety

The expression $E(\theta_2; \theta^i) \equiv \mu G(\theta^i) + \int^i \theta g(\theta) d\theta$, where the domain of integration is $[\theta^i, \bar{\theta}]$,

denotes the average worker quality in Period 2 under regime i. Since $\theta_2 = \theta_1$ when the worker is

retained, this can be re-written as:

$$E(\theta_2; \theta^i) = \mu + \int^i (\theta_1 - \mu) g(\theta_1) d\theta_1 = \mu + h(\theta^i),$$

where $h(\theta^i) \equiv \int^i (\theta_1 - \mu) g(\theta_1) d\theta_1$. Since $h(\underline{\theta}) = 0$ and $h'(\theta^i) = -(\theta^i - \mu) g(\theta^i)$, it follows that $h'(\theta^i) >$

0 (and therefore that $h(\theta^i) > 0$) for all $\theta^i < \mu$. Since $\theta^C < \theta^O < \mu$, the following proposition

summarizes average worker quality both within-regime but across periods, and within-Period 2 but

across regimes. This proposition indicates that worker quality improves over time, but less so in a

confidential regime than in an open regime.

> Proposition 3. (a) $E(\theta_2; \theta^i) > \mu$, i = C, O. That is, average worker quality improves from
>
> Period 1 to Period 2. (b) $E(\theta_2; \theta^C) < (=) E(\theta_2; \theta^O)$ as $\lambda^C < (=) \lambda^O$. That is, average worker
>
> quality in Period 2 is lower in a confidential regime than in an open regime.

A similar question can be asked regarding the average safety of products sold. In an open

regime, the average safety of products sold in Period 2 is simply N times the average worker quality

in Period 2. Let $\sigma(\theta_2; \theta^O) = N\mu$ if $\theta_1 < \theta^O$ and $\sigma(\theta_2; \theta^O) = N\theta_1$ if $\theta_1 \geq \theta^O$. Then $E(\sigma; \theta^O) = N\mu G(\theta^O)$ $+ \int^O N\theta_1 g(\theta_1) d\theta_1 = N\mu + Nh(\theta^O)$.

However, since consumers respond to asymmetric information in a C regime by being wary of purchasing (i.e., reducing the likelihood of a sale), the average safety of products sold in Period 2 is more complicated. Let $\sigma(\theta_2; \theta^O) = N\mu$ if $\theta_1 < \theta^C$ and $\sigma(\theta_2; \theta^C) = N\theta_1 s^*(\theta_1; \theta^C)$ if $\theta_1 \geq \theta^C$. Then $E(\sigma; \theta^C)$ is the average safety of products sold in Period 2 in a C regime, where:

$$E(\sigma; \theta^C) = N\mu G(\theta^C) + \int^C N\theta_1 s^*(\theta_1; \theta^C) g(\theta_1) d\theta_1$$

$$= N\mu + \int^C N[\theta_1 s^*(\theta_1; \theta^C) - \mu] g(\theta_1) d\theta_1$$

$$< N\mu + \int^C N[\theta_1 - \mu] g(\theta_1) d\theta_1$$

$$= N\mu + Nh(\theta^C) < N\mu + Nh(\theta^O) = E(\sigma; \theta^O).$$

The effect of confidentiality on the average safety of products sold in Period 2 is summarized below.

Proposition 4. $E(\sigma; \theta^C) < E(\sigma; \theta^O)$. That is, the average safety of products sold in Period 2

is lower in a confidential regime than in an open regime.

This result holds even if $\lambda^C = \lambda^O$. This is because there are two reasons why confidentiality reduces the average safety of products sold in Period 2. First, if $\lambda^C < \lambda^O$, then average worker quality will be lower in Period 2 under confidentiality (as compared to openness), so each unit produced will be of lower average safety. But even if $\lambda^C = \lambda^O$ (so that retention thresholds, wages, and average worker quality in Period 2 are the same for the two regimes), the average safety of products sold in Period 2 will still be lower in a confidential regime due to consumer wariness, since the equilibrium probability of a sale is lower for safer products (since they have higher prices).

Indeed, rational consumer wariness can be so extreme that average product safety in a confidential regime can actually decrease from Period 1 to Period 2 (we provide examples of this

below). To ascertain parameter combinations (in terms of V and t/N) under which this is likely to occur, we first note that $E(\sigma; \theta^C) < N\mu$ if and only if $\int^C N[\theta_1 s*(\theta_1; \theta^C) - \mu]g(\theta_1)d\theta_1 < 0$. Let:

$$H(V, t/N) \equiv \int^C[\theta_1 s*(\theta_1; \theta^C) - \mu]g(\theta_1)d\theta_1.$$

Then average product safety is the same in Period 1 and Period 2 when $H(V, t/N) = 0$. Suppose we begin at a parameter pair $(V, t/N)$ at which $H(V, t/N) = 0$. Then, since it can be shown (see Appendix B for details) that $\partial H/\partial V > 0$ and $\partial H/\partial(t/N) < 0$, it follows that average product safety is more likely to decline from Period 1 to Period 2 when V is low, or when t/N is high. In particular, this means that $H(V, t/N) = 0$ yields an increasing function when graphed in $(V, t/N)$ space.

Some Examples Illustrating Declining versus Improving Intertemporal Safety Provision

It is difficult to explore H in more detail analytically, so we use some examples to illustrate this surface between declining and improving intertemporal safety provision. We now fix the region of analysis and the parameter values. Since $0 \leq \theta^C \leq \mu$, this means that $0 \leq t/NL^C \leq \mu$. Further, from Assumption 1, we require $V/L^C > 1$; this is also the economically relevant region, since otherwise the product potentially generates higher social costs than value.[18] Figure 1 below illustrates these computations, for selected members of the family of Beta distributions (see Johnson and Kotz, 1970, Chapter 24); that is $G(\theta) = Beta(\theta; p, q)$, where we have chosen to use the parameter values (p,q) to be (1,1), (2,2), and (3,3).[19] These (p,q) values provide symmetric distributions, all with mean equal to ½, and with increasing "peakedness," as illustrated in the left panel of Figure 1 below.

In the figure the density functions are on the left, while (for each G) the boundary between declining and improving intertemporal safety of the average product sold is displayed on the right. For example, the case $(p,q) = (1,1)$ is the uniform distribution, whose density is illustrated on the left of the figure. The curve on the right labeled (1,1), is the resulting $H = 0$ locus, which implicitly
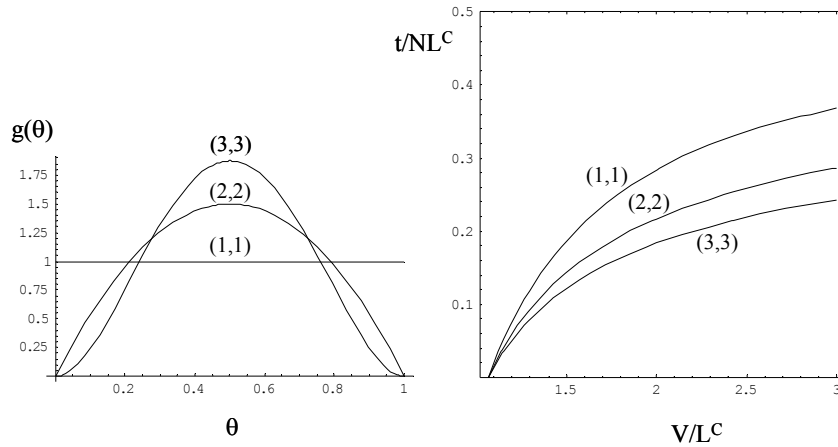
Figure 1: The Effect of Mean-Preserving Spreads on the Change in
the Equilibrium Average Safety of Products Sold Under
Confidentiality (Symmetric Distribution Case)

defines levels of t/NL^C, as a function of V/L^C, that induce Period 2 average safety of products sold exactly equal to the average safety of products sold in Period 1. Points above this curve are associated (under the uniform distribution) with declining intertemporal safety, while points below this curve are associated (under the uniform distribution) with increasing intertemporal safety. Thus, starting at a point on the curve, an increase in (say) t results in higher training costs, a lower threshold θ^C and a lower value of $s^*(\theta_1; \theta^C)$ at any $\theta_1 > \theta^C$ (see Proposition 1). Such an increase results in sufficient demand reduction to make the average safety of products sold in period 2 lower than that of period 1. A reverse effect would occur if we had increased V instead. This same discussion applies for the other densities illustrated.

Figure 1 also suggests that a distribution $\widetilde{G}$ which is a mean-preserving spread of G (as, for example, the distribution represented by $(p,q) = (1,1)$ yields a mean-preserving spread of the distribution represented by $(p,q) = (2,2)$) will result in an associated curve in $(V/L^C, t/NL^C)$ space which is everywhere higher than that curve associated with G. Unfortunately, we have not been successful in characterizing when (or under what conditions on G) mean-preserving spreads provide

the dominance suggested by the right-hand-side panel of Figure 1.[20] However, this property is intuitively reasonable. A mean-preserving spread $\tilde{G}$ of G places more weight on high types and on low types than G does. Now consider a specific level of t/NL^C (equivalently, fix a value of θ^C). While a larger proportion of types under $\tilde{G}$ is rejected due to θ^C than is rejected under G, more high types are left, too. Thus, for a given level of t/NL^C, H should be larger under $\tilde{G}$ than under G for higher values of V. This is the pattern observed above.

5. The Firm's Choice of Regime

In this section, we compare the firm's profitability under an open versus a confidential regime. In particular, we ask when a firm would find it profitable to eschew confidentiality in favor of a regime of openness. We will also consider parametric variations that affect this choice.

We re-write the firm's *ex ante* expected profits, incorporating the equilibrium wage rates, and indexing profits in the open regime by λ^O. *Ex ante* expected profits in an open regime, gross of any monitoring costs required to ensure credible commitment to openness, are:

$$\Pi_1^O(\lambda^O) = \{N[V - (1 - \mu)L^O] - w^*(\theta^O) - t\}(1 + G(\theta^O))$$

$$+ \int^O \{N[V - (1 - \theta_1)L^O] - w^*(\theta^O)\}g(\theta_1)d\theta_1. \tag{14}$$

Ex ante expected profits in a confidential regime (suppressing λ^C, which is held fixed) are:

$$\Pi_1^C = \{N[V - (1 - \mu)L^C] - w^*(\theta^C) - t\}(1 + G(\theta^C))$$

$$+ \int^C \{Ns^*(\theta_1; \theta^C)[V - (1 - \theta_1)L^C] + N[1 - s^*(\theta_1; \theta^C)]\beta\theta_1 - w^*(\theta^C)\}g(\theta_1)d\theta_1. \tag{15}$$

An open regime involves both costs and benefits relative to a confidential one. The costs of adopting an open regime involve paying more settlements (due to a higher fraction of viable suits), as well as higher training costs and higher wages (due to less frequent retention of the worker) as compared to a confidential regime. In addition, a public expenditure is required to engage in a

credible commitment to openness. On the other hand, a firm adopting a regime of openness need not deal with wary customers, which is a benefit relative to a confidential regime.

Let $M(\lambda^O) \equiv \Pi_1^O(\lambda^O) - \Pi_1^C$. This expression represents the maximum amount that a firm would be willing to pay in order to make a credible commitment to openness. When $\lambda^O = \lambda^C$, then $L^O = L^C$ and $\theta^O = \theta^C$, so $M(\lambda^C) \equiv \Pi_1^O(\lambda^C) - \Pi_1^C = \int^C \{N[1 - s^*(\theta_1; \theta^C)][V - (1 - \theta_1)L^C - \beta\theta_1]\}g(\theta_1)d\theta_1$. This expression is clearly positive; thus, when openness does not increase the fraction of viable suits in comparison with confidentiality, the firm would be willing to pay $M(\lambda^C) > 0$ to ensure a credible commitment to openness (e.g., to hire an external auditor). As shown in Appendix B, $M'(\lambda^O) < 0$. While $M(\lambda^O)$ may remain positive for all $\lambda^O \in [\lambda^C, 1]$, it might also become negative for sufficiently high values of λ^O. These properties of $M(\lambda^O)$ are summarized below in Proposition 5.

Proposition 5. $M(\lambda^C) > 0$ and $M'(\lambda^O) < 0$ for all λ^O.

In Figure 2 below, we illustrate two cases.[21] The case in which $M(\lambda^O)$ remains positive for all $\lambda^O \in [\lambda^C, 1]$ is illustrated using a solid line, while the case in which $M(\lambda^O)$ eventually falls below zero is illustrated using a dashed line; in this case, let $\hat{\lambda}$ be such that $M(\hat{\lambda}) = 0$. If the actual cost of credible monitoring, denoted m, is less than $M(\lambda^O)$, then the firm itself will choose an open regime. If $m > M(\lambda^O) > 0$, then the firm would prefer a regime of openness (if monitoring were costless), but is unwilling to pay the required amount. Finally, if $M(\lambda^O) < 0$, then the firm would prefer a confidential regime, even if credible monitoring were costless.

Alternatively put, in the case of the dashed line, if $\lambda^O < \hat{\lambda}$, then a change in the law that would eliminate all confidential settlements (e.g., by refusing to enforce them) would be supported by the firm, since it would mean that the higher profits openness would offer would be obtainable without expending money on making the commitment credible (there would be no need to pay m
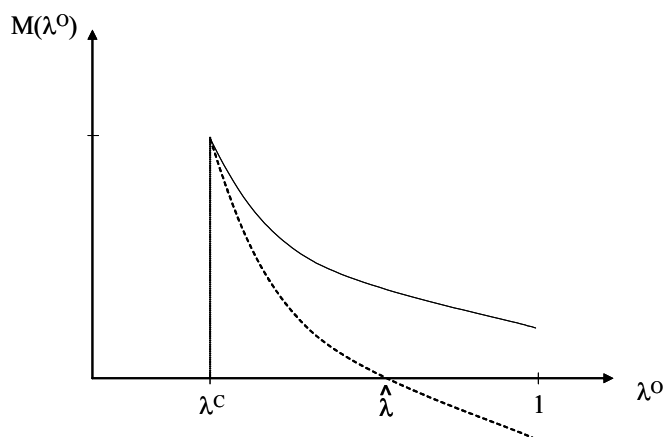
Figure 2: Maximum Willingness to Pay for
Credible Commitment for Openness

to be make the credible commitment). On the other hand, and again in the case illustrated by the

dashed line, if λ^O is to the right of $\hat{\lambda}$, then the firm would oppose the banning of confidentiality. This

is because $\lambda^O - \lambda^C$ is now too large, making confidentiality more profitable than openness.

Under our assumption of unit demand, consumers are fully-extracted in equilibrium in both

regimes.[22] Thus, they are indifferent between the two regimes. Since the firm extracts the full

surplus created, its choice between confidential and open regimes is also second-best socially

optimal (i.e., given that the monitoring costs are unavoidable, given the allocation of losses between

the parties, and given that a social planner has no greater commitment ability than that available to

the firm). That is, confidentiality could be Pareto superior if λ^O is sufficiently high (since openness

involves increased wages, training and settlement costs). The welfare impact of confidentiality is

complicated by the potential for third-party victims, which we consider below.

The Impact of Loss-Shifting on the Choice of Regime

In either regime, the firm currently faces an expected loss of L_D^i for each harmed consumer,

while the consumer herself faces an expected loss of L_P^i if harmed by the product. The combined

losses are $L^i = \delta + \lambda^i K_S$. One variation of interest would be to shift some of the firm's losses to the consumer (or vice versa), holding total losses constant. For instance, loss-shifting from the firm to the consumer could be accomplished by increasing k_{SP} and reducing k_{SD}, while holding their sum fixed. Alternatively, if the firm were liable only for a fraction of the consumer's harm, then losses would be shifted from the firm to the consumer, while total losses would be unchanged.

If some of the firm's losses were shifted to the consumer, while total losses were held constant, then $\Pi_1^O(\lambda^O)$ would be completely unchanged, since it depends on the losses only through L^O, which is being held fixed. On the other hand, Π_1^C depends upon both L^C, which is being held fixed, and on L_P^C, through the exponent in $s^*(\theta_1; \theta^C)$, which was denoted as α. Thus, to determine the effect on $M(\lambda^O; \alpha) \equiv \Pi_1^O(\lambda^O) - \Pi_1^C(\alpha)$ of a shift of losses from D to P, holding total losses fixed, we need only determine the sign of $\partial M/\partial \alpha = -\partial \Pi_1^C/\partial \alpha$. Differentiating equation (15) with respect to $\alpha = L_P^C/(L^C - \beta)$, holding L^C fixed, yields:

$$-\partial \Pi_1^C/\partial \alpha = -\int^C N(\partial s^*(\theta_1; \theta^C)/\partial \alpha)[V - (1 - \theta_1)L^C - \beta\theta_1]g(\theta_1)d\theta_1. \tag{16}$$

The integrand is negative for all $\theta_1 \in (\theta^C, \bar{\theta}]$, since $\partial s^*(\theta_1; \theta^C)/\partial \alpha = s^*(\theta_1; \theta^C)\ln\{[V - (1 - \theta^C)L^C - \beta\theta^C]/[V - (1 - \theta_1)L^C - \beta\theta_1]\} < 0$. Thus, an increase in L_P^i, holding L^i fixed (i.e., an increase in α), increases $M(\lambda^O; \alpha)$ for all λ^O. A firm is willing to pay more for openness as L_P^C increases because this shift makes consumers more wary, and the further reduction in their purchases (in a C regime) makes confidentiality less appealing. Alternatively, a shift of losses from P to D (through shifting of settlement costs or awarding multiple damages (i.e., damages in excess of actual harm) will reduce consumer wariness and thus make confidentiality more attractive to the firm.

Impact of Liability for Third-Party Harms on the Firm's Choice of Regime

If a product is subject to failure causing harm, it need not harm only those who purchased

the product. Often there will be innocent bystanders or other third parties who are also harmed. For instance, when a defective gun misfires, both the user and nearby individuals are at risk. Similarly, when a defective part in an automobile fails, the resulting crash may injure both the driver and third parties (passengers, people in other vehicles, pedestrians). According to tort law for products liability, "... the courts have almost unanimously allowed recovery for bystanders where injury to them is reasonably foreseeable, ..." (See Keeton, et. al., 1989, p. 179).

We could define parameters for third-party victims that are analogous to δ and λ^i, which would result in expressions analogous to L_P^i, L_D^i and L^i, but this complicates the exposition unnecessarily. Rather, we will assume that these parameters are the same for consumer victims and third-party victims, and we will simply assume that the consumption of one unit by a consumer exposes an additional ϕ individuals to the same risk of harm. This interpretation allows us to simply substitute $\widetilde{L}_D^i = (1 + \phi)L_D^i$ into the profit functions. The consumer still faces the same L_P^i, which is transmitted back to the firm (through the market) to obtain $\widetilde{L}^i = L_P^i + \widetilde{L}_D^i = L_P^i + (1 + \phi)L_D^i$. Moreover, each of the ϕ individuals per consumer also face a loss of L_P^i, which does not get transmitted back through the market or the legal system to the firm. Thus, we can conclude immediately that $\partial\theta^i/\partial\phi > 0$; an increase in third-party exposure increases the retention threshold. However, since the uncompensated losses borne by the third parties are not reflected in market prices or firm liability costs, the retention threshold increases less than it should.

Note that, in order to preserve the existence of a revealing equilibrium, we now must have $\beta > \widetilde{L}_D^i$. As mentioned earlier, should this not hold, a pooling equilibrium will result instead. Since liability for third-party harms induces a non-marginal change, it is readily possible that $\widetilde{L}_D^i > \beta > L_D^i$. This is of more than technical interest, since, as will be shown in Section 6 below, the retention

threshold under the pooling equilibrium is <u>lower</u> than that under the revealing equilibrium. We will

return to this in Section 6. For now, we assume that ϕ is such that $\beta > \widetilde{L}_D^i$.

We can now write the firm's maximum willingness to pay for a credible commitment to

openness as $M(\lambda^O; \phi) \equiv \Pi_1^O(\lambda^O; \phi) - \Pi_1^C(\phi)$ and ask how an increase in ϕ (that is, greater liability

for third-party losses) affects the firm's preference between the O and C regimes. First note that

$M(\lambda^O; \phi)$ is of the same form as before (except that L^i and L_D^i have been replaced by $\widetilde{L}^i$ and $\widetilde{L}_D^i$).

Thus, for any fixed value of ϕ the graph of $M(\lambda^O; \phi)$ looks similar to that displayed in Figure 2.

Notice also that $\Pi_1^C(\phi)$ can be re-written as follows:

$$\Pi_1^C(\phi) = \Pi_1^O(\lambda^C; \phi) - \int^C N[1 - s*(\theta_1; \theta^C)][V - (1 - \theta_1)\widetilde{L}^C - \beta\theta_1]g(\theta_1)d\theta_1. \tag{17}$$

This implies that $M(\lambda^O; \phi)$ is of the form:

$$M(\lambda^O; \phi) = \Pi_1^O(\lambda^O; \phi) - \Pi_1^O(\lambda^C; \phi)$$

$$+ \int^C N[1 - s*(\theta_1; \theta^C)][V - (1 - \theta_1)\widetilde{L}^C - \beta\theta_1]g(\theta_1)d\theta_1. \tag{18}$$

While we are unable to determine the sign of $\partial M(\lambda^O; \phi)/\partial\phi$ for all values of λ^O, we can

provide sufficient conditions for $\partial M(\lambda^O; \phi)/\partial\phi < 0$ for λ^O sufficiently close to λ^C. The derivatives

of the first two terms in equation (18) cancel out when $\lambda^O = \lambda^C$; moreover, the derivative involving

the lower limit of integration in the third term is also zero (upon recalling that $1 - s*(\theta^C; \theta^C) = 0$).

Since the second bracketed term in the integrand is decreasing in ϕ, the derivative of the integrand

will be negative if $\partial s*(\theta_1; \theta^C)/\partial\phi \geq 0$. This derivative is actually quite complex, since $s*(\theta_1; \theta^C)$

depends on $\widetilde{L}^C = L_P^C + (1 + \phi)L_D^C$ directly, through $\theta^C = \mu - t/N\widetilde{L}^C$ and through $\alpha = L_P^C/(\widetilde{L}^C - \beta)$. In

Appendix B we derive a sufficient condition for $\partial s*(\theta_1; \theta^C)/\partial\phi \geq 0$ for all $\theta_1 \in [\theta^C, \bar{\theta}]$.[23]

Under the condition that $\partial s*(\theta_1; \theta^C)/\partial\phi \geq 0$ for all θ_1, an increase in the firm's liability costs

associated with third-party harms permits the consumers to moderate their wariness. Essentially,

incentives for the firm to truthfully reveal its type come from two sources: lawsuits (either from consumers or third parties) and demand reduction on the part of consumers. When the firm faces higher costs of dealing with third parties' lawsuits, the consumers need not engage in as much demand reduction; they can "free ride" on the third-party lawsuits. This reduction in consumer wariness increases the firm's sales in a C regime, making confidentiality more profitable, at least for λ^O in a neighborhood of λ^C. While this intuition continues to seem plausible as λ^O increases, we have been unable to sign the second mixed partial, $\partial^2 M(\lambda^O; \phi)/\partial\lambda^O\partial\phi = \partial^2\Pi_1^O(\lambda^O; \phi)/\partial\lambda^O\partial\phi$, whose dependence on λ^O is complex.

The welfare effects of confidentiality are more complicated when third parties may also be harmed. We have already noted that the retention threshold (and thus average product safety) will be too low in equilibrium in both the open and confidential regimes (since $\widetilde{L}^i$ does not include ϕL_P^i, it does not represent the full social loss). As before, consumers are fully extracted, so they do not have a preference regarding the regime. However, it is clear that confidentiality can never be Pareto superior to an open regime, since third parties will always prefer openness.

6. Analysis of the Confidential Regime when $\beta < L_D^C$

We have shown that a revealing equilibrium exists when $\beta > L_D^C$. In a revealing equilibrium, a firm with a safer product must demand a higher price (and must suffer more demand-reduction). Thus, a revealing equilibrium can only exist if a firm with a safer product is willing to absorb a reduction in volume in exchange for a higher price. Recalling the firm's profit function (equation (4)), we see that the type that will be most willing to suffer a given reduction in demand is the type for which $p_2 - (1 - \theta_1)L_D^C - \beta\theta_1$ is the smallest (since this represents the foregone profit, net of the opportunity cost, from selling one fewer units of the product). Since this expression is decreasing

in θ_1 when $\beta > L_D^C$, the safest type suffers the least from demand-reduction. Consequently, firms with safer products are willing to suffer more demand-reduction in return for higher prices. However, when $\beta < L_D^C$, the firm with the safest product suffers the <u>most</u> from demand-reduction. In this case, there cannot be a perfect Bayesian equilibrium involving revelation; any perfect Bayesian equilibrium involves complete pooling (see Appendix A for a formal statement and proof).

Beliefs for the consumer now take the following form. If the firm (in a confidential regime) retains its worker, then consumers believe that $\theta_1 \in [\Theta, \bar{\theta}]$. Since the equilibrium involves complete pooling, the maximum price consumers are willing to pay is given by $V - (1 - \mu(\Theta))L_P^C$, where $\mu(\Theta)$ is the conditional mean of θ_1, given that $\theta_1 \in [\Theta, \bar{\theta}]$. That is, $\mu(\Theta) \equiv \int \theta_1 g(\theta_1)d\theta_1/(1 - G(\Theta))$, where the integration is over $\theta_1 \in [\Theta, \bar{\theta}]$. Notice that: (a) $\mu(\underline{\theta})$ is the unconditional mean (which we will continue to denote simply by μ); (b) $\mu(\Theta) > \Theta$ for all $\Theta < \bar{\theta}$; and (c) $\mu'(\Theta) > 0$. Moreover, Assumption 1 and the fact that $\beta < L_D^C$ imply that $V - (1 - \mu(\Theta))L_P^C - (1 - \theta_1)L_D^C > \beta\theta_1$ for all Θ and $\theta_1 \in [\Theta, \bar{\theta}]$. Thus, every type of firm prefers to sell a unit rather than to employ the worker in alternative activities. Hence, all types of firms will sell N units.

Firm profits in Period 2 following retention of the worker therefore become:

$$\Pi_2^C(r; \theta_1, \Theta) = N[V - (1 - \mu(\Theta))L_P^C - (1 - \theta_1)L_D^C] - w_r^C. \tag{19}$$

These profits are clearly increasing in θ_1; that is, safer products are more profitable. Thus the form of consumers' beliefs is rationalized, and we can find the worst type of worker retained by equating these profits to the profits from replacing the worker, $\Pi_2^C(n) = N[V - (1 - \mu)L^C] - w_n^C - t$. Again, assuming $w_r^C = w_n^C$, the worst worker retained in a pooling equilibrium, denoted θ^{CP}, is given by:

$$N[V - (1 - \mu(\theta^{CP}))L_P^C - (1 - \theta^{CP})L_D^C] = N[V - (1 - \mu)L^C] - t. \tag{20}$$

Recall that the worst worker retained in the revealing equilibrium satisfies $N[V - (1 - \theta^C)L_P^C -$

$(1 - \theta^C)L_D^C] = N[V - (1 - \mu)L^C] - t$. Since $\mu(\theta^C) > \theta^C$, it follows that $N[V - (1 - \mu(\theta^C))L_P^C - (1 - \theta^C)L_D^C]$ $> N[V - (1 - \mu)L^C] - t$. Thus, while the firm is indifferent about replacing the type θ^C worker in the revealing equilibrium, it strictly prefers to retain this worker in the pooling equilibrium. Therefore, the retention threshold when $\beta < L_D^C$ (i.e., in the pooling equilibrium) is yet lower than the retention threshold when $\beta > L_D^C$ (i.e., in the revealing equilibrium); that is, $\theta^{CP} < \theta^C$. *A fortiori*, $\theta^{CP} < \theta^O$.

The results stated in Propositions 2-4 apply equally to the comparison between confidential and open regimes when the confidential regime is characterized by a pooling equilibrium, with some minor differences. We briefly summarize these results below without their formal re-statements.

The retention threshold for workers is strictly lower in a confidential regime; that is, $\theta^{CP} < \theta^O$. This holds now even if $\lambda^C = \lambda^O$, because the less safe products can obtain the higher pooling price for their products. The firm pays lower wages (and expected training costs) in a confidential regime, since it replaces the worker less often; that is, $w^*(\theta^{CP}) < w^*(\theta^O)$. Average worker quality always improves from Period 1 to Period 2 in both regimes, but average worker quality in Period 2 is higher in an open regime than in a confidential regime. The average safety of products sold in Period 2 is lower in a confidential regime than in an open regime (however, the average safety of products sold in a confidential regime cannot decline from Period 1 to Period 2); this is now a direct consequence of lower average worker quality, since there is no consumer wariness in equilibrium.

Results analogous to those in Proposition 5 can be obtained when the input is interpreted as a technology, but it is considerably less clear that a firm would be willing to pay for openness when the input is interpreted as a worker. Note that now the maximum willingness to pay for openness is given by $M(\lambda^O) \equiv \Pi_1^O(\lambda^O) - \Pi_1^{CP}$, where:

$$\Pi_1^{CP} = \{N[V - (1 - \mu)L^C] - w^*(\theta^{CP}) - t\}(1 + G(\theta^{CP}))$$

$$+ \int \{N[V - (1 - \mu(\theta^{CP}))L_P^C - (1 - \theta_1)L_D^C] - w*(\theta^{CP})\}g(\theta_1)d\theta_1,$$

and where the domain of integration is $[\theta^{CP}, \bar{\theta}]$. It is straightforward to show that the functions Π_1^O and Π_1^{CP} are equal when $\lambda^O = \lambda^C$ *and they are evaluated at the same threshold value.* With a slight abuse of notation, we write this function as $\Pi_1^O(\lambda^C; \theta)$. Of course, when $\lambda^O = \lambda^C$, we have shown that the threshold values have the ranking $\theta^O = \theta^C > \theta^{CP}$. Thus, $M(\lambda^C) > (<) \ 0$ as $\Pi_1^O(\lambda^C; \theta^C) > (<)$ $\Pi_1^O(\lambda^C; \theta^{CP}) = \Pi_1^{CP}$.

The function $\Pi_1^O(\lambda^C; \theta)$ is clearly increasing in θ for all $\theta < \theta^C$ when there are no wages involved (see Appendix B for details), which implies that $M(\lambda^C) > 0$. As before, this willingness to pay for a credible commitment to openness decreases as λ^O increases, since $M'(\lambda^O) < 0$. This is the same result as in Proposition 5, which is illustrated in Figure 2.

The function $\Pi_1^O(\lambda^C; \theta)$ is more complicated when the input is labor, as terms involving the equilibrium wage are involved. We can show that it is decreasing at θ^C, but may be either increasing or decreasing at θ^{CP} (again, see Appendix B for details). If $\Pi_1^O(\lambda^C; \theta)$ is decreasing at θ^{CP} (which occurs when θ^{CP} is sufficiently close to θ^C), then the firm is never willing to pay to openness. If $\Pi_1^O(\lambda^C; \theta)$ is increasing at θ^{CP}, then there may be a positive willingness to pay for openness at $\lambda^O = \lambda^C$, which declines as λ^O rises. Thus, when $\beta < L_D^C$ and the input is interpreted as labor, secrecy may be pervasive: a firm may never be willing to pay for openness and, having chosen a confidential regime, its safety is not revealed by its price.

Third-Party Harms and Pooling

Recall that in the discussion of firm liability for third-party harms, we recognized that β could be such that $\widetilde{L}_D^i > \beta > L_D^i$. Thus, while a revealing equilibrium would exist without firm liability for third-party harms (since $\beta > L_D^i$), their inclusion in the liabilities faced by the firm might

result in a level of losses for the firm such that $\widetilde{L}_D^i > \beta$. Accounting for the dependence of θ^{CP} and

θ^C on the level of losses, let us briefly employ the notation $\theta^{CP}(\bullet)$ and $\theta^C(\bullet)$. We know that $\theta^{CP}(\widetilde{L}^C)$

$> \theta^{CP}(L^C)$, and that $\theta^C(\widetilde{L}^C) > \theta^C(L^C)$. Since $\theta^{CP}(\bullet) < \theta^C(\bullet)$, this means that it is possible that, should $\widetilde{L}_D^i$

$> \beta > L_D^i$, then $\theta^{CP}(\widetilde{L}^C) < \theta^C(L^C)$. Thus, while third parties would now receive some compensation

for their harms, the shift from a revealing equilibrium to a pooling equilibrium could mean that third

parties (as well as consumers) might also suffer more accidents.

7. Summary and Policy Implications

Summary of Results

We found that, independent of the type of equilibrium (that is, revealing or pooling),

confidentiality leads to lower second-period average input quality, lower retention thresholds and

lower second-period average safety of the product sold than occurs under openness. Moreover, if

conditions support the revealing equilibrium, a second force influences second-period average

safety: consumer wariness. In the revealing equilibrium, consumers reduce their demand for the

product (in comparison with a firm committed to openness). Moreover, this demand reduction can

be so severe that the average safety of the product sold actually declines across periods.

Further, we developed the firm's demand for auditing services that would make commitment

to openness credible. We showed that (at least in the revealing equilibrium case and in the pooling

case when the input is a technology), when openness does not generate significantly more viable

cases than arise under confidentiality ($\lambda^C < \lambda^O < \hat{\lambda}$) or if there is no $\hat{\lambda}$ such that $M(\hat{\lambda}) = 0$, this

demand is positive, so that if auditing costs were low enough, firms would elect to pay them and

eschew confidentiality. However, we also found that conditions may arise such that, when openness

yields sufficiently more cases than would arise under confidentiality, the demand for such auditing

may be zero and that firms would prefer to employ confidentiality. While consumers have no preference over regime (because of their unit demand), third parties prefer openness.

Is it reasonable to posit firms paying for independent auditing to guarantee credibility of a commitment to openness? As mentioned in the Introduction, in the GE-Westinghouse competition in large turbine generators in the 1960's and 1970's, GE ended up doing just that: they employed an accounting firm to monitor all contracts and provide independent authority that GE was adhering to an announced "most-favored-customer" policy which gave full rebates to early buyers from any price cuts provided to later buyers. This was the means by which GE and Westinghouse stabilized otherwise intense price competition which repeatedly had involved secret price concessions.[24]

Policy Implications

Alternatively, when there is a positive demand for a credible commitment to openness, statutes and/or court-instigated procedural rules can make such commitment free by making confidential discovery and/or settlement agreements unenforceable. By unenforceable, this means refusing to: 1) issue protective orders which severely limit of the results of discovery; 2) seal settlements; and 3) enforce breach clauses in contracts of silence.

But a blanket ban on confidentiality casts a wide net, and there are important issues which have not been addressed in our analysis that may give one pause. First, privacy issues (both for individuals, such as in medical malpractice cases, and for firms, such as in terms of trade secrets) suggest that a complete ban is unlikely to be socially optimal. One should note, however, that privacy (for individuals or firms, or both) is the usual motive for requesting confidentiality (see Hare, et. al., 1988), and that the current controversy over the employment of confidentiality seemingly reflects extensive abuse of this "exception."

Second, banning confidentiality will raise bargaining costs due to increases in the number of trials if there is asymmetric information in the bargaining subgame (see Daughety and Reinganum, 1999, 2002); these costs are in excess of the ones considered in our analysis, since they are due to bargaining failure which results in trial. Third, it is possible that even substantially-restricted confidentiality may drive more bargains outside of judicial oversight, via contracts of silence, which themselves only come to light in case of breach. Since such contracts are currently available, this means that those diverted to their use (if judicially-imposed sealing is banned) would face more inefficient enforcement than they currently prefer. Moreover, any chance for judicial monitoring of harms that might involve substantial negative externalities (which should become known to regulators) would be further reduced.[25]

Fourth, casual observation indicates that, from the perspective of products liability: 1) few (if any) firms commit to openness; and 2) most consumers (if newspaper accounts and recent legislative ire are indicative) are only now becoming aware of the widespread use of confidentiality.[26] As consumers become increasingly aware of the widespread use of confidentiality, they can be expected to become more wary. Firms employing confidentiality can then expect to suffer either reduced demand (in the case of the revealing equilibrium), or a lower expected second-period price (in the case of the pooling equilibrium). Thus, firms should increasingly find it preferable to eschew confidentiality, and they could be assisted by the private provision of specialized auditing services, by well-tailored sunshine laws and by increased judicial restraint with respect to issuing protective and sealing orders, all of which would lower the cost of achieving a credible commitment to openness.

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Appendix A

Characterization of Revealing Equilibrium in a Confidential Regime

Definition. A <u>perfect Bayesian equilibrium</u> (in a confidential regime) consists of:

(a) beliefs Θ and $b(p_2; \Theta) \subseteq [\Theta, \bar{\theta}]$ for the consumer;

(b) a probability of sale function $s(p_2; \Theta)$ for the consumer; and

(c) a retention threshold θ^C and a price function $p_2^*(\theta_1)$ for retained workers such that:

(i) $s(p_2; \Theta)$ maximizes the consumer's expected payoff, given her beliefs Θ and $b(p_2; \Theta)$;

(ii) $p_2^*(\theta_1)$ and the retention threshold θ^C maximize the firm's expected payoff, given $s(p_2; \Theta)$; and

(iii) beliefs are correct in equilibrium; that is, $\Theta = \theta^C$ and $b(p_2^*(\theta_1); \theta^C) = \theta_1$ for all $\theta_1 \in [\theta^C, \bar{\theta}]$.

<u>Claim 1</u>. When $\beta > L_D^C$, then: (a) The following beliefs and strategies provide a revealing perfect Bayesian equilibrium in a confidential regime; and (b) this is the unique perfect Bayesian equilibrium that survives refinement using D1 (Cho and Kreps, 1987).

(i) Upon observing that the worker (or product design) was retained, the consumer believes that $\Theta = \mu - (w_n^C + t - w_r^C)/NL^C$. Upon observing a price $p_2 \in [V - (1 - \Theta)L_P^C, V - (1 - \bar{\theta})L_P^C]$, the consumer believes that θ_1 is given by $b(p_2; \Theta) = 1 - (V - p_2)/L_P^C$. Upon observing a price outside this interval, the consumer's beliefs are arbitrary elements of $[\Theta, \bar{\theta}]$.

(ii) The probability of sale function is $s(p_2; \Theta) = \{A/B\}^\alpha$, where $A = V - (1 - \Theta)L_P^C + [\beta V - \beta L_P^C - VL_D^C]/[L^C - \beta]$, $B = p_2 + [\beta V - \beta L_P^C - VL_D^C]/[L^C - \beta]$, and $\alpha = L_P^C/(L^C - \beta) > 1$, for $p_2 \in [V - (1 - \Theta)L_P^C, V - (1 - \bar{\theta})L_P^C]$. Note that $A > 0$, $B > 0$ and $B > A$ for all $p_2 \in [V - (1 - \Theta)L_P^C, V - (1 - \bar{\theta})L_P^C]$. For $p_2 < V - (1 - \Theta)L_P^C$, the probability of sale is $s(p_2; \Theta) = 1$ and for $p_2 > V - (1 - \bar{\theta})L_P^C$, the probability of sale is $s(p_2; \Theta) = 0$.

(iii) The retention threshold is $\theta^C = \mu - (w_n^C + t - w_r^C)/NL^C$; that is, workers with $\theta_1 < \mu - (w_n^C + t - w_r^C)/NL^C$ are replaced, while those with $\theta_1 \geq \mu - (w_n^C + t - w_r^C)/NL^C$ are retained. The price function for products produced by retained workers is $p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$ for $\theta_1 \in [\theta^C, \bar{\theta}]$.

<u>Proof of Claim 1</u>. We provide only the proof of part (a) below; the complete proof of part (b) can be obtained by adapting the arguments from Reinganum and Wilde (1986), which uses iterated D1 (Universal Divinity; see Banks and Sobel, 1987) since only one iteration is required. However, we note here a few critical attributes of the uniqueness proof. In a revealing equilibrium, the function $s(p_2; \Theta)$ must be decreasing (if higher prices also result in no fewer sales, they will be mimicked) and continuous from the left on the equilibrium price interval (a jump, which must be downward, would induce a defection to a lower price by types whose (higher) equilibrium prices lie in a neighborhood of the price at which the jump occurs). The same argument implies that $s(p_2; \Theta) = 1$ when p_2 is the lowest equilibrium price. A jump can occur after the highest equilibrium price, since there are no types with a higher equilibrium price that might be tempted to defect downward. Finally, since $s(p_2; \Theta)$ is decreasing and continuous on the equilibrium price interval, it is differentiable almost everywhere, and therefore must satisfy the differential equation provided in the text. Solving this equation through the specified boundary condition provides a unique candidate for a revealing equilibrium. The remainder of the proof verifies that this is a revealing equilibrium

when $\beta > L_D^C$.

First, we note that, given the beliefs specified in (i), the consumer is indifferent between buying and not buying at any price $p_2 \in [V - (1 - \Theta)L_P^C, V - (1 - \bar{\theta})L_P^C]$. This is because if she buys at price p_2, she expects surplus of $V - p_2 - [1 - (1 - (V - p_2)/L_P^C]L_P^C = 0$. Thus it is optimal for the consumer to randomize as specified in (ii). Any price $p_2 > V - (1 - \bar{\theta})L^C$ will yield negative surplus, regardless of the consumer's inferred value of $\theta_1 \in [\Theta, \bar{\theta}]$, so it is optimal to buy with probability zero. Finally, any price $p_2 < V - (1 - \Theta)L_P^C$ will yield positive surplus, regardless of the consumer's inferred value of $\theta_1 \in [\Theta, \bar{\theta}]$, so it is optimal to buy with probability one. Thus, given the consumer's beliefs as in (i), the probability of sale function given in (ii) is optimal.

Given the probability of sale function in (ii), the firm with retained worker of type θ_1 receives profits of $\Pi_2^C(r; \theta_1, \Theta) = \max_{p_2} Ns(p_2; \Theta)[p_2 - (1 - \theta_1)L_D^C] + N[1 - s(p_2; \Theta)]\beta\theta_1 - w_r^C$. First note that any price $p_2 < V - (1 - \Theta)L_P^C$ is dominated by the price $p_2 = V - (1 - \Theta)L_P^C$ since both result in a sure sale. Any price $p_2 > V - (1 - \bar{\theta})L_P^C$ is dominated by $p_2 = V - (1 - \bar{\theta})L_P^C$ since the former price results in no sale and the latter results in a positive probability of sale at a profitable price. Differentiating with respect to p_2 and collecting terms implies that $s' = -\alpha s/B < 0$ and $s'' = \alpha(\alpha + 1)s/B^2 > 0$. The first-order condition $s'[p_2 - (1 - \theta_1)L_D^C - \beta\theta_1] + s = 0$ has the unique solution $p_2 = p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$. To see that this provides a maximum, we evaluate the second-order condition:

$$s''[p_2 - (1 - \theta_1)L_D^C - \beta\theta_1] + 2s' = [\alpha(\alpha + 1)s/B^2][p_2 - (1 - \theta_1)L_D^C - \beta\theta_1] - 2\alpha s/B$$

$$= [\alpha s/B^2][(1 + \alpha)(p_2 - (1 - \theta_1)L_D^C - \beta\theta_1) - 2B]$$

at $p_2 = p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$. Upon making this substitution, the term $[(1 + \alpha)(p_2 - (1 - \theta_1)L_D^C - \beta\theta_1) - 2B]$ reduces to $[(L_D^C - \beta)/(L^C - \beta)][V - (1 - \theta_1)L^C - \beta\theta_1] < 0$. Thus, the function $p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$ provides the unique interior maximum. Moreover, if there were another maximum at either end of the interval $[V - (1 - \Theta)L_P^C, V - (1 - \bar{\theta})L_P^C]$, then there would have to be an interior minimum between $p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$ and that endpoint. Since $p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$ is the unique solution to the first-order condition, there can be no interior minimum. Hence, $p_2^*(\theta_1) = V - (1 - \theta_1)L_P^C$ is the optimal price, given $s(p_2; \Theta)$.

Since the resulting payoff $\Pi_2^C(r; \theta_1, \Theta) = Ns(p_2^*(\theta_1); \Theta)[p_2^*(\theta_1) - (1 - \theta_1)L_D^C] + N[1 - s(p_2^*(\theta_1); \Theta)]\beta\theta_1 - w_r^C$ is an increasing function of θ_1 (this was demonstrated in the text), the retention interval will be of the form $[\Theta, \bar{\theta}]$, with the worst retained worker satisfying $\Pi_2^C(r; \theta, \theta) = \Pi_2^C(n)$; that is, $\Pi_2^C(r; \theta, \theta) = N[V - (1 - \theta)L^C] - w_r^C = N[V - (1 - \mu)L^C] - w_n^C - t$. Solving for the worst worker retained yields $\theta^C = \mu - (w_n^C + t - w_r^C)/NL^C$.

It is clear that firms with workers of types $\theta_1 > \theta^C$ are better off retaining their workers. It remains to verify that a firm with a worker of type $\theta_1 < \theta^C$ would not want to deviate from replacing the worker to retaining the worker and charging some price $p_2 \in [V - (1 - \theta^C)L_P^C, V - (1 - \bar{\theta})L_P^C]$. The best price for a firm with a worker of type $\theta_1 < \theta^C$ is $p_2 = V - (1 - \theta^C)L_P^C$, which yields a sure sale (this is because lower quality workers have lower value in alternative uses). But then the firm's

profit is $N[V - (1 - \theta^C)L_P^C - (1 - \theta_1)L_D^C] - w_r^C < N[V - (1 - \theta^C)L_P^C - (1 - \theta^C)L_D^C] - w_r^C = N[V - (1 - \mu)L^C] - w_r^C - t$. Thus, a firm with a worker of type $\theta_1 < \theta^C$ prefers to replace the worker. Finally, it is straightforward to verify that the consumer's beliefs are correct in equilibrium. QED.

Diagrams for H = 0 When the Distribution is Not Symmetric

In what follows we use the same parameter values as employed in the text, except for the (p,q) pairs associated with the beta distribution. Figure A1 displays results for three mean-
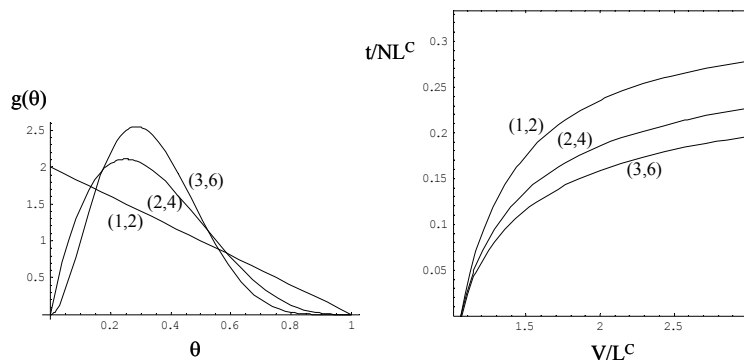

Figure A1: The Effect of Mean-Preserving Spreads on the Change in
the Equilibrium Average Safety of Products Sold Under
Confidentiality (Left-Skewed Distribution Case)

preserving left-skewed distributions ($\mu = 1/3$), while Figure A2 displays results for three mean-
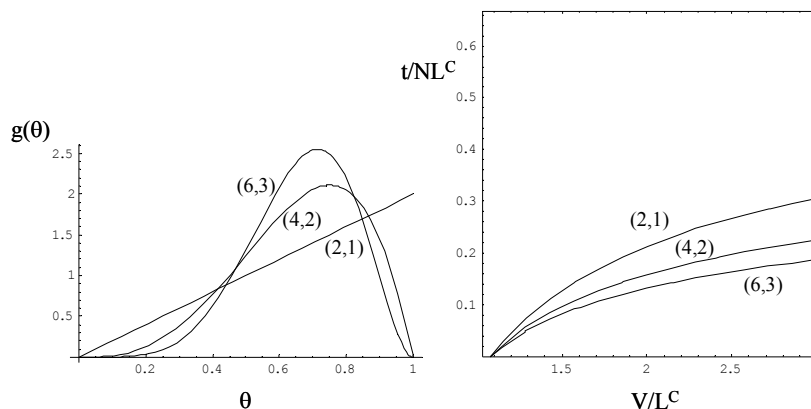

Figure A2: The Effect of Mean-Preserving Spreads on the Change in
the Equilibrium Average Safety of Products Sold Under
Confidentiality (Right-Skewed Distribution Case)

preserving right-skewed distributions ($\mu = 2/3$). Note that the diagrams on the right of Figures A1 and A2 are for the space $[1, 3] \times [0, \mu]$ and that μ for Figure A1 is 1/3 while μ for Figure A2 is 2/3.

Claim 2. When $\beta < L_D^C$, then any perfect Bayesian equilibrium must involve pure pooling. The

following beliefs and strategies provide a perfect Bayesian equilibrium that survives D1.

i) Upon observing that the worker was retained, the consumer believes that $\Theta = \theta^{CP}$, which is defined implicitly (and uniquely) by $N[V - (1 - \mu(\theta^{CP}))L_P^C - (1 - \theta^{CP})L_D^C] = N[V - (1 - \mu)L^C] - t$. Upon observing the price $p_2 = V - (1 - \mu(\theta^{CP}))L_P^C$, the consumer believes $\theta_1 \in [\theta^{CP}, \bar{\theta}]$ and is distributed according to $g(\theta_1)/(1 - G(\theta^{CP}))$ on this interval. Upon observing a price $p_2 < V - (1 - \mu(\theta^{CP}))L_P^C$, the consumer may entertain arbitrary beliefs, and upon observing a price $p_2 > V - (1 - \mu(\theta^{CP}))L_P^C$, the consumer believes that $\theta_1 = \Theta = \theta^{CP}$.

(ii) The consumer buys with probability one for $p_2 = V - (1 - \mu(\theta^{CP}))L_P^C$, and buys with probability zero for $p_2 > V - (1 - \mu(\theta^{CP}))L_P^C$. The consumer buys according to her beliefs for $p_2 < V - (1 - \mu(\theta^{CP}))L_P^C$ (since she buys for sure at $p_2 = V - (1 - \mu(\theta^{CP}))L_P^C$, no firm type will ever price lower).

(iii) The retention threshold is θ^{CP} as defined above; that is, that is, workers with $\theta_1 < \theta^{CP}$ are replaced, while those with $\theta_1 \geq \theta^{CP}$ are retained. The price function for products produced by retained workers is $p_2^*(\theta_1) = V - (1 - \mu(\theta^{CP}))L_P^C$, for all $\theta_1 \in [\theta^{CP}, \bar{\theta}]$.

<u>Proof of Claim 2</u>. It is straightforward to verify that the strategies and beliefs provided constitute a pooling equilibrium. Technically, any price $p_2 \in [V - (1 - \theta^{CP})L_P^C, V - (1 - \mu(\theta^{CP}))L_P^C]$ can be supported as a PBE since upward deviations are inferred to come from type θ^{CP}, and are therefore rejected. However, the PBE specified in Claim 2 is the natural analog of those characterized in Section 3. The more interesting part of this claim is that there can be no revelation in equilibrium. To see why, suppose there is partial revelation. This could take one of the following forms: (a) an interval of types who reveal according to the price function $p(\theta_1) = V - (1 - \theta_1)L_P^C$; or (b) an interval of types $[\theta^-, \theta^+]$ partitioned by a marginal type θ^m, so that the types $[\theta^-, \theta^m)$ prefer the price P_2^-, the types $(\theta^m, \theta^+]$ prefer the price $p_2^+ > p_2^-$ and type θ^m is indifferent between these two prices. We argue that neither of these can be part of an equilibrium.

(a) As argued above in the proof of Claim 1, if an interval of types reveals according to the price function $p(\theta_1) = V - (1 - \theta_1)L_P^C$, then these types face a decreasing and continuous probability of sale function $s(p_2)$ which must satisfy the differential equation (6) from the text. The solution to this equation is of the form $s(p_2) = \{\Delta/[p_2(L^C - \beta) + \beta V - \beta L_P^C - VL_D^C]\}^\alpha$, where $\alpha \equiv L_P^C/(L^C - \beta)$. (The constant of integration Δ need not be evaluated here, as we will show that a contradiction arises regardless of this value). Checking the second-order condition, evaluated at $p(\theta_1) = V - (1 - \theta_1)L_P^C$ (see the proof of Claim 1), implies that this price now provides an interior <u>minimum</u> when $\beta < L_D^C$. Thus, an equilibrium involving this sort of partial revelation cannot exist.

(b) In the second candidate for an equilibrium involving partial revelation, the prices and corresponding probabilities of sale must satisfy: $p_2^+ > p_2^-$ and $s(p_2^+) < s(p_2^-)$ (if the higher price also achieves at least as high a sales volume, then it will be mimicked). Since θ^m must be indifferent between the two prices, $s(p_2^+)[p_2^+ - (1 - \theta^m)L_D^C] + [1 - s(p_2^+)]\beta\theta^m - s(p_2^-)[p_2^- - (1 - \theta^m)L_D^C] - [1 - s(p_2^-)]\beta\theta^m = 0$. However, this difference is decreasing in θ^m (since $s(p_2^+) < s(p_2^-)$ and $\beta < L_D^C$), so types in $(\theta^m, \theta^+]$ would prefer to defect from their putative equilibrium price of p_2^+ to p_2^-. Thus, an equilibrium involving this sort of partial revelation cannot exist. QED.

Appendix B (to be made available on the Web)

<u>Proof of Proposition 1</u>. Write $s^*(\theta_1; \theta^C) = \{A/B\}^\alpha$, where $A = V - (1 - \theta^C)L^C - \beta\theta^C$, $B = V - (1 - \theta_1)L^C - \beta\theta_1$, and $\alpha = L_P^C/(L^C - \beta)$. Note that $A > 0$, $B > 0$ and $B > A$ for $\theta_1 > \theta^C$. Then $s^{*\prime}(\theta_1; \theta^C)$ $= -\alpha s^*(L^C - \beta)/B < 0$ and $s^{*\prime\prime}(\theta_1; \theta^C) = \alpha(1 + \alpha)s^*[(L^C - \beta)/B]^2 > 0$. The parameters V and β enter directly, and do not affect θ^C. Differentiation yields:

$\partial s^*(\theta_1; \theta^C)/\partial V = \alpha s^*(L^C - \beta)(\theta_1 - \theta^C)/AB > 0$ for all $\theta_1 \in (\theta^C, \bar\theta]$ (and $= 0$ for $\theta_1 = \theta^C$).
$\partial s^*(\theta_1; \theta^C)/\partial\beta = \alpha s^*[\ln\{A/B\}/(L^C - \beta) + (V - L^C)(\theta_1 - \theta^C)/AB]$.

Let $\gamma(\theta_1) \equiv \ln\{A/B\}/(L^C - \beta) + (V - L^C)(\theta_1 - \theta^C)/AB$. Since $\gamma(\theta^C) = 0$ and $\gamma'(\theta_1) = -(L^C - \beta)\theta_1/B^2 < 0$, it follows that $\gamma(\theta_1) < 0$ for all $\theta_1 \in (\theta^C, \bar\theta]$. Thus, $\partial s^*(\theta_1; \theta^C)/\partial\beta < 0$ for all $\theta_1 \in (\theta^C, \bar\theta]$ (and $= 0$ for $\theta_1 = \theta^C$). The parameters N, t and μ enter only indirectly through θ^C. Since $\partial s^*(\theta_1; \theta^C)/\partial\theta^C = \alpha s^*(L^C - \beta)/A > 0$, it follows that $\text{sgn}\{\partial s^*(\theta_1; \theta^C)/\partial\rho\} = \text{sgn}\{\partial\theta^C/\partial\rho\}$ for $\rho = $ N, t or μ. Since $\theta^C = \mu - (w_n^C + t - w_r^C)/NL^C$, we have $\partial s^*(\theta_1; \theta^C)/\partial N > 0$; $\partial s^*(\theta_1; \theta^C)/\partial\mu > 0$; and $\partial s^*(\theta_1; \theta^C)/\partial t < 0$. QED.

<u>Partial Derivatives of H(V, t/N)</u>.
Recall that $H(V, t/N) \equiv \int^C[\theta s^*(\theta; \theta^C) - \mu]g(\theta)d\theta$, where $\theta^C = \mu - t/NL^C$. In the text, we claimed that (a) $\partial H/\partial V > 0$; and (b) $\partial H/\partial(t/N) < 0$.
<u>Proof of (a)</u>. $\partial H/\partial V = \int^C\theta_1(\partial s^*(\theta_1; \theta^C)/\partial V)g(\theta_1)d\theta_1$. Recall that $\partial s^*(\theta_1; \theta^C)/\partial V > 0$ for all $\theta_1 \in (\theta^C, \bar\theta]$, and $\partial s^*(\theta_1; \theta^C)/\partial V = 0$ for $\theta_1 = \theta^C$ (see Proposition 1). Since θ^C itself is independent of V, it is clear that $\partial H/\partial V > 0$.
<u>Proof of (b)</u>. $\partial H/\partial(t/N) = (\theta^C - \mu)g(\theta^C)/L^C + \int^C\{\theta_1[\partial s^*(\theta_1; \theta^C)/\partial(t/N)]\}g(\theta_1)d\theta_1$. The first term is negative since $\theta^C < \mu$. The second term is negative since $\partial s^*(\theta_1; \theta^C)/\partial(t/N) < 0$ for all $\theta_1 \in [\theta^C, \bar\theta]$ (see Proposition 1). Thus, $\partial H/\partial(t/N) < 0$. QED.

<u>Proof that $M'(\lambda^O) < 0$</u>.
Notice that: $M'(\lambda^O) = d\Pi_1^O(\lambda^O)/d\lambda^O$
$= \{N[- (1 - \mu)K_S] - w^{*\prime}(\theta^O)(d\theta^O/d\lambda^O)\}(1 + G(\theta^O))$
$+ \{N[V - (1 - \mu)L^O] - w^*(\theta^O) - t\}g(\theta^O)(d\theta^O/d\lambda^O)$
$- \{N[V - (1 - \theta^O)L^O] - w^*(\theta^O)\}g(\theta^O)(d\theta^O/d\lambda^O)$
$+ \int^O\{N[- (1 - \theta_1)K_S] - w^{*\prime}(\theta^O)(d\theta^O/d\lambda^O)\}g(\theta_1)d\theta_1$.

Since $w^{*\prime}(\bullet) > 0$ and $d\theta^O/d\lambda^O > 0$, the first and fourth lines above are both negative. The two middle lines correspond to $\Pi_2^O(n) - \Pi_2^O(r; \theta^O)$, which cancel each other out by the definition of the retention threshold θ^O. Thus, $M'(\lambda^O) < 0$.

<u>Details of the Impact of Third Party Harms on $M(\lambda^O; \phi)$</u>.
Notice that (upon recalling that $1 - s^*(\theta^C; \theta^C) = 0$):

$\partial M(\lambda^O; \phi)/\partial\phi = \partial\Pi_1^O(\lambda^O; \phi)/\partial\phi - \partial\Pi_1^O(\lambda^C; \phi)/\partial\phi$

$+ \int^C N\{[-\partial s^*(\theta_1; \theta^C)/\partial\phi][V - (1 - \theta_1)\tilde{L}^C - \beta\theta_1] + [1 - s^*(\theta_1; \theta^C)][-(1 - \theta_1)L_D^C\}g(\theta_1)d\theta_1$.

The first two terms cancel out when $\lambda^O = \lambda^C$, and the integrand will surely be negative if $\partial s^*(\theta_1; \theta^C)/\partial\phi \geq 0$. A sufficient condition for $\partial s^*(\theta_1; \theta^C)/\partial\phi \geq 0$ for all $\theta_1 \in [\theta^C, \bar{\theta}]$ is:

$$-(V - \tilde{L}^C)\ln\{(V - \tilde{L}^C)/(V - \beta)\} - (\tilde{L}^C - \beta) + (t/N)((\tilde{L}^C - \beta)/\tilde{L}^C)^2 \geq 0. \tag{B1}$$

To see this, notice that the function $s^*(\theta_1; \theta^C)$ depends on ϕ only through $\tilde{L}^C$; thus $\partial s^*(\theta_1; \theta^C)/\partial\phi = (\partial s^*(\theta_1; \theta^C)/\partial\tilde{L}^C)(\partial\tilde{L}^C/\partial\phi)$. Since $\partial\tilde{L}^C/\partial\phi > 0$, we need only find a sufficient condition for $\partial s^*(\theta_1; \theta^C)/\partial\tilde{L}^C \geq 0$ for all $\theta_1 \in [\theta^C, \bar{\theta}]$. Differentiating $s^*(\theta_1; \theta^C)$ with respect to $\tilde{L}^C$ yields:

$$\partial s^*(\theta_1; \theta^C)/\partial\tilde{L}^C = [\alpha s^*/A(\tilde{L}^C - \beta)]\{ -A\ln\{A/B\} + (V - \beta)(A - B)/B + (t/N)((\tilde{L}^C - \beta)/\tilde{L}^C)^2\},$$

where $A \equiv V - (1 - \theta^C)\tilde{L}^C - \beta\theta^C$ and $B \equiv V - (1 - \theta_1)\tilde{L}^C - \beta\theta_1$. Let $\eta(\theta_1) \equiv -A\ln\{A/B\} + (V - \beta)(A - B)/B + (t/N)((\tilde{L}^C - \beta)/\tilde{L}^C)^2$. Then $\eta(\theta^C) = (t/N)((\tilde{L}^C - \beta)/\tilde{L}^C)^2 > 0$ and $\eta'(\theta_1) = -A(\tilde{L}^C - \beta)^2(1 - \theta_1)/B^2 < 0$. Thus, a sufficient condition for $\partial s^*(\theta_1; \theta^C)/\partial\tilde{L}^C \geq 0$ for all $\theta_1 \in [\theta^C, \bar{\theta}]$ is that $\eta(\bar{\theta}) \geq 0$. The worst-case scenario is provided by $\bar{\theta} = 1$.

Upon substituting $\theta^C = \mu - t/N\tilde{L}^C$, we can see that $\eta(1; \mu) = -[V - (1 - \mu + t/N\tilde{L}^C)\tilde{L}^C - \beta(\mu - t/N\tilde{L}^C)]\ln\{[V - (1 - \mu + t/N\tilde{L}^C)\tilde{L}^C - \beta(\mu - t/N\tilde{L}^C)/(V - \beta)\} - (1 - \mu + t/N\tilde{L}^C)(\tilde{L}^C - \beta) + (t/N)((\tilde{L}^C - \beta)/\tilde{L}^C)^2$. If we wanted to guarantee that $\eta(1; \mu) \geq 0$ <u>for all</u> μ, we would want it to be non-negative in the worst-case scenario. Since $\partial\eta(1; \mu)\partial\mu = -(\tilde{L}^C - \beta)\ln\{[V - (1 - \mu + t/N\tilde{L}^C)\tilde{L}^C - \beta(\mu + t/N\tilde{L}^C)]/(V - \beta)\} > 0$, the worst-case scenario occurs when μ is as small as possible. In order to keep θ^C non-negative, this means that the lowest possible value of μ is $\mu = t/N\tilde{L}^C$. Evaluating $\eta(1; \mu)$ at $\mu = t/N\tilde{L}^C$ yields: $\eta(1; t/N\tilde{L}^C) = -(V - \tilde{L}^C)\ln\{(V - \tilde{L}^C)/(V - \beta)\} - (\tilde{L}^C - \beta) + (t/N)((\tilde{L}^C - \beta)/\tilde{L}^C)^2 \geq 0$ under the displayed condition (B1). Thus, this condition ensures that $\eta(1; \mu) \geq 0$ for all $\mu \in [t/N\tilde{L}^C, 1]$, which implies $\partial s^*(\theta_1; \theta^C)/\partial\tilde{L}^C \geq 0$ (and thus $\partial s^*(\theta_1; \theta^C)/\partial\phi \geq 0$) for all $\theta_1 \in [\theta^C, \bar{\theta}]$. QED.

<u>Properties of the function $\Pi_1^O(\lambda^C; \theta)$ for the Pooling Analysis</u>
This function is given by:
$$\Pi_1^O(\lambda^C; \theta) \equiv \{N[V - (1 - \mu)L^C] - w^*(\theta) - t\}(1 - G(\theta))$$
$$+ \int \{N[V - (1 - \theta))L_P^C - (1 - \theta_1)L_D^C] - w^*(\theta)\}g(\theta_1)d\theta_1,$$
and where the domain of integration is $[\theta, \bar{\theta}]$. Differentiating and collecting terms implies:
$$\partial\Pi_1^O(\lambda^C; \theta)/\partial\theta = -2w^{*\prime}(\theta) + [(\mu - \theta)NL^C - t]g(\theta)$$
$$= [(\theta^C - \theta)NL^C - 4(w_a - \underline{w})/(2 - G(\theta))^2]g(\theta).$$
When the input is interpreted as a technology, the wage terms drop out and it is clear that $\partial\Pi_1^O(\lambda^C; \theta)/\partial\theta > 0$ for all $\theta < \theta^C$. Thus, $\Pi_1^O(\lambda^C; \theta^C) > \Pi_1^O(\lambda^C; \theta^{CP}) = \Pi_1^{CP}$ and hence $M(\lambda^C) > 0$. When the input is interpreted as labor, then the wage terms become relevant, and we have $\partial\Pi_1^O(\lambda^C; \theta^C)/\partial\theta < 0$ and $\partial\Pi_1^O(\lambda^C; \theta^{CP})/\partial\theta$ of ambiguous sign. The term in square brackets is decreasing in θ, so if $\partial\Pi_1^O(\lambda^C; \theta^{CP})/\partial\theta < 0$ (which occurs if θ^{CP} is sufficiently close to θ^C), then $\Pi_1^O(\lambda^C; \theta)$ is decreasing for all $\theta \in [\theta^{CP}, \theta^C]$. In this case, $\Pi_1^O(\lambda^C; \theta^C) < \Pi_1^O(\lambda^C; \theta^{CP}) = \Pi_1^{CP}$ and hence $M(\lambda^C) < 0$; there is no demand for openness, even at $\lambda^O = \lambda^C$. On the other hand, if $\partial\Pi_1^O(\lambda^C; \theta^{CP})/\partial\theta > 0$, then it is possible (but not necessary) that $\Pi_1^O(\lambda^C; \theta^C) > \Pi_1^O(\lambda^C; \theta^{CP}) = \Pi_1^{CP}$ and hence $M(\lambda^C) > 0$.

Endnotes

1. See the *Manual for Complex Litigation, Third Edition* (1995), section 21.431-432, for details on protective orders (which provide for sealing of discovery and subsequent materials). The *Manual*, which is published by the Federal Judicial Center, is a case management guide for judges. The section cited discusses the benefits of "umbrella" protective orders sought early in cases likely to involve extensive discovery. See Garfield (1998) for a discussion of contracts of silence.

2. See Hare, et. al., (1988), a text for attorneys on obtaining/opposing confidentiality orders; they indicate that seeking such orders in products liability cases is "routine." See also Nissen (1994).

3. See *Boston Globe* (2002) on the employment of confidential settlements by the Catholic Archdiocese of Boston. Weiser and Walsh (1988a,b,c,d) unearthed a number of examples wherein confidential settlements have been used, including: products liability in the automobile (GM's gas tank placement) and pharmaceutical (Pfizer's Feldene and McNeil's Zomax) industries; professional malpractice (by doctors, nurses, lawyers and hospitals); safety hazards in public facilities; and race- and sex-based employment discrimination cases.

4. An example of a firm paying for a credible commitment to openness is discussed in "General Electric vs. Westinghouse in Large Turbine Generators (A, B and C)," (A, Porter and Ghemawat,1980; B and C, Porter, 1980a,b); we return to this example in Section 7.

5. See, for example, Collins (2002). Note that such court-instigated changes, and some recently-considered state "sunshine" statutes (with the exception of one enacted in Texas), generally do not apply to unfiled agreements (see Gale Group, 2003). Thus, for example, contracts of silence with penalties for breach would likely still be enforceable.

6. Some recent commentators and court cases have also argued that using courts to resolve private settlement contract disputes implies a public right of access to judicial proceedings; see Dore (1999) and *Herrnreiter v. Chicago Housing Authority*, 281 F.3d 634, 636-637 (7th Circuit, 2002).

7. Milgrom and Roberts (1986) first considered a formal model of a monopoly signaling unobservable quality via price and advertising; see also Hertzendorf (1993), which assumes imperfectly-observed advertising. Some papers have considered quality signaling via price and adverstising when there are competitive forces, either because of entry deterrence considerations (e.g., Linnemer, 1998) or in response to existing rivalry (e.g., Hertzendorf and Overgaard, 2001, and Fluet and Garella, 2002).

8. If this activity involves production of an alternative product, we assume that its sale takes place after the primary product has been sold. That is, consumers of the primary product cannot observe θ by monitoring the alternative activity prior to making their purchase decisions.

9. If harm is stochastic, but verifiable to the parties at the time of settlement, then δ can be viewed as the average harm.

10. Since settlement and litigation are represented by a complete information game, there will be no trials. Empirically, a high percentage of suits result in settlement (or are withdrawn); see Gross and Syverud (1996) or Dore (1999). Theoretically, the model could be extended to allow for settlement bargaining failure, such as might result under asymmetric information (e.g., if the level of damages were private information for each plaintiff); see Hay and Spier (1998) or Daughety (2000) for surveys of this literature. The possibility of trial would mean that even under confidentiality, there would be some possibility of consumers using this to update their estimate of θ, which would substantially complicate the analysis of the model; we abstract from this possibility.

11. See Gross and Syverud (1996) for an extensive empirical study of civil suits in California.

12. In the alternative interpretation that the input is a technology rather than a worker, there will be no wages and t will be the R&D cost associated with inventing a new technology.

13. Here D's disagreement payoff does not include effects on his continuation payoffs. None arise in an open regime (or in Period 2 in either regime). We abstract from such effects in a confidential regime as well, under the assumption that any <u>single</u> P choosing trial has a negligible effect on λ^C and on the consumer's estimate of θ^C (e.g., trial establishes that D's product harmed this P, but does not reveal the extent of others who might have been harmed). Alternatively, if D has all the bargaining power, each P settles for her disagreement payoff (D's disagreement payoff is irrelevant).

14. While consumers harmed in Period 1 who did not have viable suits are not constrained by a confidentiality agreement, neither can they prove their harm was due to use of the product.

15. Moreover, it can also be shown that this is the unique perfect Bayesian equilibrium that survives Cho and Kreps' (1987) refinement D1.

16. Since under confidentiality only the firm knows θ_1, when hiring a worker the contract cannot depend upon θ_1. Thus neither the second-period wage, nor the retention decision, can be conditioned on θ_1 in the contract (since it is not verifiable whether θ_1 is below or above θ^C). To maintain comparability, we assume the same simple contract structure holds for the open regime.

17. If we assumed instead that a newly-hired worker in Period 2 requires only the wage w_a, then θ^i would be defined implicitly by $\theta^i = \mu - (t + w_a - w^*(\theta^i))/NL^i$. If we assumed that a newly-hired worker in Period 2 requires a wage of $2w_a - \underline{w}$ (since he is sure to be fired in the second period), then θ^i would be defined implicitly by $\theta^i = \mu - (t + 2w_a - \underline{w} - w^*(\theta^i))/NL^i$. As long as the relevant equation has a unique solution, Propositions 2-4 (and Proposition 5, with a suitably-modified definition of $M(\lambda^O)$) continue to hold as stated.

18. In the computations below, we have assumed: 1) $1 < V/L^C \leq 3$; 2) $L_P^C/L^C = 0.5$; and 3) $[\underline{\theta}, \bar{\theta}] = [0, 1]$. Note that $L_P^C/L^C = 0.5$ and $\beta > L_D^C$ implies that $\beta/L^C > 0.5$; we have chosen to use $\beta/L^C = 0.6$. Runs with higher values of β/L^C gave very similar results.

19. These calculations were performed using *Mathematica 4.2*.

20. In Appendix A we investigate some Beta distributions which are left- or right-skewed, and they evidence the same mean-preserving-spread property for the associated $H = 0$ curves.

21. $M(\lambda^O)$ is drawn as a convex function of λ^O. This can be shown for the case wherein the input is interpreted as a technology, but in the labor case the curvature is ambiguous.

22. The welfare impact of confidentiality is likely to be considerably more complex with downward-sloping demand. In this case, output distortions will also contribute to distortions in the retention thresholds, the average safety of products sold, and the choice between regimes.

23. This condition is $-(V - \tilde{L}^C)\ln\{(V - \tilde{L}^C)/(V - \beta)\} - (\tilde{L}^C - \beta) + (t/N)((\tilde{L}^C - \beta)/\tilde{L}^C)^2 \geq 0$. This is a very strong (but non-empty) sufficient condition, ensuring against the worst of the worst-case scenarios, namely when μ is as small as possible (i.e., $\mu = t/N\tilde{L}^C$), making $\theta^C = 0$, and when $\bar{\theta} = 1$.

24. The practice continued from 1963 until the Justice Department objected and threatened suit in 1975. See Porter and Ghemawat (1980) and Porter (1980 a,b).

25. But see Weiser (1989) for an example of the use of judicially-supervised sealing that prevented information about leaks of trichloroethylene, a suspected carcinogen, by the Xerox Corporation's Webster (NY) plant, into the groundwater. The court's sealing order on the settlement between plaintiffs and Xerox limited the ability of victims to cooperate with public health agencies.

26. Confidential settlement recently figured in the Ford/Firestone product recalls. Womeldorf and Cravens (2001) report that "One consequence of the recent Firestone recalls has been a resurgence of legislative proposals aimed at ferreting out 'secrecy' in litigation."