Evidence Production, Adversarial Process
and the Private Instigation of Suits

by

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A companion paper, Sanchirico (1997) introduces the concept of "endogenous cost evidence" in a model of single-agent, mandatory hearings. The current paper extends Sanchirico (1997) by adding multiple parties and allowing for the possibility that agents may choose both whether to attend the hearing and whether to compel others to attend. The paper's main contribution is its identification of a fundamental trade-off in civil law design. Essentially, there are two ways to create incentives via civil process: costly evidence production and reliance on opponent reports (a la the literature on correlated types). The drawback of costly evidence production is that evidence costs are a deadweight loss to the system. The drawback of relying on opponent reports is that attaining sufficient information may require holding hearings in many different circumstances and requiring the attendance of many ancillary parties, which can also be costly. We show that the optimal mix of these two types of implementation depends on the size of the "fixed costs" of hearings. This dependence on fixed costs may help explain a climacteric transformation in civil process that took place in England between 1750 and 1850.

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2 This draft is based on the second half of the December 1995 draft (which was distributed in working paper format as Sanchirico (1996)). The first half of the December 1995 draft appears in Sanchirico (1997).
We imagine the state as principal to a population of agents who choose, outside of the principal’s range of vision, whether/how to engage in a particular activity with external effects. The question is how to align incentives in this activity through a system of civil law suits. The classic example in law and economics is driving, where some agents choose how carefully to drive, while others choose how carefully to cross the street. Both choices affect the likelihood and severity of accidents and are the subject of subsequent litigation.

The question is of interest theoretically because civil law-style incentive setting is structurally distinct from the usual hidden action problem considered in economics. In particular, it differs in two fundamental respects, both of which might be thought of as components of the state’s “passivity.”

In a sense, the state sets incentives without ever getting up from behind the judge’s bench. On the one hand, it waits for claims to come to it: it never solicits cases, nor does it require or induce universal participation. On the other hand, it decides the claims that do arise based solely on what the parties choose to place or perform within its limited scope of vision, i.e. what “evidence” the parties “produce” in court. The state conducts no independent investigation. Nor is it privy to any analogue of the output signal received by the employer in the classic work incentive problem. That is, it receives no signals that are exogenous conditional on the agent’s action—the signals (evidence) it receives following the agent’s choice of actions are also choice variables for the agent.3

A companion paper, Sanchirico (1997) studies this second aspect of the state’s passivity. That paper introduces the concept of “endogenous cost evidence” in a model of single-agent,
mandatory hearings. Essentially, a signaling game (the "hearing") is appended to the usual hidden action/moral hazard model, with the key ingredient being that signaling costs ("evidence production costs") at the hearing are dependent on action choice. The basic mechanic in this model is explained by example in the first few paragraphs of Section 1.

The current paper focuses on the first aspect of the state's passivity. It extends Sanchirico (1997) by adding multiple parties and allowing for the possibility that agents may choose both whether to attend the hearing and whether to compel others to attend. The paper's main contribution is its identification of a fundamental trade-off in civil law design. This trade-off is explained in more detail in the simple example comprising Section 1. Essentially, there are two ways to create incentives in the underlying activity via civil process. The first is the sort of costly evidence production identified in Sanchirico (1997). The drawback of this method is precisely that the evidence is costly: these costs are a deadweight loss to the system, a cost of "incentivizing." The other way to set incentives is to rely on the reports of "opponent" parties in a manner similar to that identified in the mechanism design literature that considers correlated types (see, e.g., the discussion in Fudenberg and Tirole [1991]). The drawback here is that attaining sufficient information for this sort of implementation may require holding hearings in many different circumstances and requiring the attendance of many ancillary parties. If such hearings have "fixed costs," costs that are incurred even if no costly evidence is produced, this sort of implementation may be quite expensive. We show in Theorem 2 that the optimal mix of these two types of implementation depends on the relative size of fixed costs. When fixed costs are low, it is best to rely as much as possible on opponent reports and so hold many hearings.

3 In the classic employee/employer problem, for instance, once the employee has chosen her level of effort, the distribution of output, what the principal observes, is fixed. In particular, after the agent chooses her effort, what the
with many in attendance. When fixed costs are high, it is best to minimize the number of hearings and make up the shortfall in incentives by costly evidence production. For middling fixed costs, the optimal system is mixed—much like the actual system in force today.

The manner in which this trade-off is affected by fixed costs may help us to understand the transformation in civil process that took place in England sometime between 1750 and 1850. Prior to this transformation, a party’s ability to present evidence on her own behalf was greatly limited by the rule of “disqualification for interest.” Further, juries were not meant to be impartial, but were rather chosen precisely for their knowledge of the incident and parties in dispute. Thus in early civil process, costly evidence production played a limited role, and rewards and punishments were based almost solely on the relatively rich array of “opponent” reports. Over time, however, the jury decreased in size, shed its role as witness and became, along with the judge, a decision maker rather than a provider-of-information. (Indeed, those with knowledge of the parties or the event were now specifically excluded). Simultaneously, evidence production by the parties themselves came to assume the prominent role that it has today.

This paper suggests linking this institutional transformation to increases in the fixed costs of hearings wrought from increases in the marginal product of labor attendant to industrialization. Recent historical scholarship lends some support to this interpretation. Formerly, it was generally believed that the transformation in legal process referred to above occurred sometime between 1500 and 1700. Recently, however, Langbein (1996) has provided compelling evidence that at least disqualification for interest was still in effect as late as 1750, which places the legal transformation closer in time to the industrial revolution in England.

principal sees is not a choice variable for the agent.
The trade-off between the fixed and variable costs of hearings does not appear elsewhere in the literature. On information and belief, no paper in the literature even considers the civil proceeding as a multi-agent problem with correlated types. Those papers that do analyze costly litigation (e.g. Ordover [1978, 1981] and Polinsky and Rubinfeld [1988]) consider only the fixed cost component of litigation costs: in this case there is no sense in which inducing fewer suits (i.e. lower attendance) means that each suit must be more expensive in terms of costly evidence production.

The paper makes several ancillary contributions. First, it endogenously derives the private instigation of suits. Private instigation is the manner in which the uninformed court regulates which agents appear in court under which circumstances. Again, this is made clear by way of example in Section 1.

Second, the paper provides a new argument for decoupling liability from recovery. To the extent that we rely on opponent information, we should not restrict ourselves to “balance the budget” within each trial; in particular we should decouple plaintiff’s award and defendant’s punishment. Balancing the budget within each trial unnecessarily adds another constraint to our implementation problem, and thus requires opponent information of higher dimension to accomplish the same in terms of incentives. This argument for decoupling is distinct from those that have appeared elsewhere in the literature (See Polinsky and Che [1991]).

Third, our analysis also suggests conceptually decoupling suits from accidents—whether a given event should trigger a suit depends, *inter alia*, on the degree to which it generates both rich

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4 We mean opponent here in the game theoretic sense, not the litigation sense, i.e. a player’s opponent is any player in the game beside himself.
opponent observation and evidence costs characterized by large differences and low absolute levels. Whether this sometimes or always corresponds to accidents is an empirical question.

Fourth, the model derives from informational and incentive considerations a fundamental characteristic of the civil process: namely that the individual making the complaint (the "plaintiff") is always present at the hearing.

The next section provides a detailed discussion of the paper's fundamental trade-off using a simple example. The model appears in Sections 2 and 3.

While the focus of this paper is on the civil law, it should be noted that the points made here have more general application. The analysis bears on any hidden action problem, single or multiple agent, in which the agent or agents have control over the information on which the principal bases her transfers. Examples include reports by corporate managers to their boards, reports by utilities to their regulating agencies, in-office auditing by the Internal Revenue Service or the Environmental Protection Agency—any setting in which the principal regulates a hidden action not by onsite visit or independent investigation, but solely on the basis of information supplied by the agent or agents.

1 Example

Suppose to start that a single agent chooses a level of care in an activity that may cause harm to others. Sometime after her choice of care, the agent appears at a "hearing" before the court/principal. There the agent presents evidence of her choosing and based on this the principal imposes liability on the agent according to a pre-announced liability per evidence schedule. This is essentially the structure proposed in Sanchirico (1997). In this example we
suppose that there are only three care levels whose private costs to the agent are listed in the fourth column of Table I: more care is more costly.

Without any intervention by the principal, the agent will take the lowest level of care, since harm born by others is of no concern to her. Depending on the cost of doing so, the principal, who cares about both the agent’s private costs and the expected harm imposed on others, may wish to induce the agent to take care level 2 or 3. Throughout the remainder of this section we study the “subproblem” of inducing the agent to take care level 2 at least social cost. Were a similar analysis conducted for care level 3 we could decide based on private costs, harm costs and implementation costs, which level to induce. (The general model analyzes the full problem of choosing both which action to implement and how best to implement it.)

The principal’s problem is complicated by the fact that it cannot directly observe the agent’s level of care. Neither does the principal receive an exogenously generated signal of care level as in the classic moral hazard analysis. Rather the principal observes only what evidence the agent chooses to place before it in the court room. To keep the example simple, we will suppose that aside from presenting no case at all, there is one possible case available to the agent, evidence A. Importantly, suppose that the cost of presenting A varies with the agent’s level of care. Sanchirico (1997) establishes that such “endogenous cost evidence” is the only way that the court can enforce more than the lowest care level based solely on evidence presented by the agent. The precise costs are given in the fifth column of Table I: the cost decreases in care level.

The principal sets the agent’s liability according to whether the agent presents A. If so, the agent pays $l(A)$ to the court; if not, $l(\emptyset)$. The numbers $l(A)$ and $l(\emptyset)$ are announced to the
agent before he chooses care level. Since only the difference $l(A) - l(\emptyset)$ matters in this model, we can assume that $l(A) = 0$.

![Table 1: Data for Example](image)

Let $V_i$, $i = 1, 2, 3$ denote the agent's best possible payoffs at the hearing, incorporating optimal evidence choice, for each care level. We will call the differences $V_2 - V_1$ and $V_2 - V_3$ the *hearing advantage* of care level 2 over 1 and 3 respectively. In order to induce care level 2, the principal must choose $l(\emptyset)$ so that these exceed the respective *(net) additional private cost* of care level 2 over 1 and 3. That is, implementation of 2 requires $V_2 - V_1 \geq 100 - 60 = 40$ and $V_2 - V_3 \geq 100 - 150 = -50$.

With this in mind, let us examine how the hearing advantage for 2 changes as we vary $l(\emptyset)$. In doing so we take account of changes in the agent's choice of evidence as a result of changes in $l(\emptyset)$. (The following analysis is made thorough and explicit to prepare the reader for subsequent application to a more complicated setting.) The dotted line in Figure 1 shows hearing payoffs $V_3$ for care level 3 as a function of $l(\emptyset)$. When the agent takes care level 3, the cost of
presenting evidence A is 50. Thus, in the range where \( l(\emptyset) \) is below 50, the agent prefers not to produce A and his hearing payoffs fall one for one in \( l(\emptyset) \). When \( l(\emptyset) \) exceeds 50, the agent prefers to pay the cost of presenting A rather than suffer the greater punishment for not doing so. After this point, his hearing payoffs remain constant at the cost of A, 50. The hearing payoffs for action 2 and action 1 are shown with dashed and solid lines respectively. These have the same form as hearing payoffs for action 3, except that since evidence costs are greater for these care levels, it requires more to induce the agent to present evidence A.

![Diagram of hearing payoffs](image)

*Figure 1: Hearing Payoffs with Single Agent, Mandatory Hearings ala Sanchirico (1997)*

The dark right angle in Figure 2 shows all possible hearing advantages for care level 2. As we increase \( l(\emptyset) \), we eventually move down from the origin, and then once \( l(\emptyset) \) reaches 100 we turn right, finally stopping at the coordinates (50, -50). Along the vertical section of the dark line only care level 3 presents A. Along the horizontal section, both 2 and 3 present A. At the point (50, -50) all three care levels present A.
Also indicated in Figure 2 is the additional private cost of action $2(40,-50)$, located at the corner formed by the two dashed lines. Implementing care level 2 means creating a hearing advantage for care level 2 that exceeds $(40,-50)$. Graphically, this means creating a hearing advantage vector that falls inside the (infinite) box whose southwestern corner is formed by the dashed lines. We see from Figure 2 that this is possible—for example, by setting $L(\emptyset)$ large enough so that all care levels present A. The cost of implementing care level 2 in this manner is that the agent will be presenting evidence A, having taken action 2, which means a loss of 100. This is the sort of analysis conducted in Sanchirico (1997).

![Figure 2: Possible Hearing Advantages for Action 2, Single Agent Mandatory Hearings](image)

In this paper we add other agents. In general (and in the general model) these agents will also have choices to make in the underlying activity that also have social ramifications. These additional agents might, for example, be potential victims who are also capable of preventative action. To keep this example manageable, we will simply suppose that a second agent, with no
care level choice, imperfectly observes the care level taken by the first. From here on we’ll call the first agent the “caretaker” and the second the “observer.”

We will assume that the observer receives one of three possible signals, Low, Medium or High. The probability of each signal, given the caretaker’s care level, is listed in the first three columns of Table I. We interpret these signals as the observer’s noisy observation of the caretaker’s care choice; perhaps L, which is more likely at lower care levels, corresponds to the observer’s observation of an accident in which he is himself a victim.

The first thing to notice is that the addition of a second party renders costly evidence production unnecessary in implementing care level 2. The principal will be able to implement 2 by requiring the observer to attend the hearing and report the signal he saw, and then conditioning the caretaker’s liability on the observer’s report. Of course, we have to worry about the observer’s incentive to lie. But so long as the principal insures that the observer’s own payoffs are not affected by his report (e.g. we simply set his payoffs at zero in all circumstances), he has no incentive to lie and the principal will find out what signal was realized as if he saw it with his own eyes. The resulting simple hidden action problem is illustrated in Figure 3. Again, we graph 2’s hearing advantage and require that it exceed 2’s additional private cost. The darkest vector corresponds to the high signal, the lightest to the low signal and the middle tone to the medium signal. (Ignore the dotted vector for now.) Each vector represents the hearing advantage for care level 2 in the case in which the principal charges the caretaker $100 when the corresponding signal is reported by the observer. For example, the lightest arrow corresponds to the ordered pair \((20,-30)\). If the principal charges the caretaker $100 whenever the low signal is reported, 2’s hearing advantage over 1 is \(\frac{1}{2}(-100)-\frac{1}{3}(-100) = 20\), while 2’s hearing advantage
over 3 is $-4(-100) + 1(-100) = -30$. The set of all possible hearing advantages is then the set of all linear combinations of these three vectors. Since these vectors span the space, we can certainly find some linear combination that takes us into the dashed box. We can thus implement 2 in this manner—and for free, since costly evidence production was not employed.

![Diagram](image)

*Figure 3: Using Only the Observer's Signal*

But is this implementation really for free? Even though no evidence was actually produced, the hearing itself entails “fixed costs:” the cost of the physical plant, the salaries of the staff, most importantly the cost in terms of the lost productive behavior of the attending agents. Let us suppose that the cost of the hearing is $F$ for each agent in attendance and that these costs are born in the first instance by the agents themselves. The cost of the implementation in the previous paragraph is not then zero, but $2F$. 
As soon as we acknowledge that hearings have fixed costs, it becomes clear that we should attempt to hold them as rarely as possible. Notice then that two of the vectors in Figure 3 are enough to create incentives for care level 2, since two of the vectors span the space. We stand to gain then by not holding hearings when one of the signals is observed. In particular, the Low signal has the highest probability when the caretaker chooses care level 2, and so it is best to eliminate hearings in the circumstance where the signal is Low. The cost of implementation would then be \((1-.4)F^2 = (1.2)F\).

Actually, it is not as simple as this. The principal does not himself observe the signal and it would seem then that the principal faces a “catch 22”: in order to know that the signal is Low and that a hearing should not be held, he must in fact hold a hearing. But there is a way out of this—via the private instigation of suits. Suppose we endow the observer with the right to instigate the hearing: that is, we allow the observer to “file suit” as he wishes. Suppose we also introduce a reward structure for the observer based on what the caretaker tells us, one that induces the observer to file suit only in the case that he sees a High or Medium signal. If we can accomplish this, the observer’s failure to attend will operate like a report that the signal is Low. Importantly, it will be a report that is costlessly sent, since the agent communicates the report specifically by not calling for the hearing.

To make this concrete, suppose for the sake of simplicity that both caretaker and observer see exactly the same signal, High Low or Medium. (Thus, we are supposing here that their signals are perfectly correlated, though we need only say that they are correlated “enough.”) We say to the observer that we will reimburse him for his fixed costs of attendance, if and only if the caretaker tells us that the signal is either High or Medium. The caretaker will not lie because his
payoffs will still depend only on the observer’s report and not on his own. Then it will only be in
the observer’s interest to bring the suit when he sees a High or Medium signal. We have thus
used the private instigation of suits to lower the expected cost of implementation from $2F$ to
$(.3+.3)2F = (1.2)F$.

Now, we might be tempted to continue in this vein, holding hearings for only one signal
value in order to further lower expected fixed costs. Unfortunately, it is not possible to induce
the caretaker to take care level 2 solely by conditioning on the observer’s report when only one
signal leads to a hearing. Suppose, for example, that we set the observer’s incentives so as to
inspire suit, only when the signal is Low. Now we learn either that the signal is Medium (when
the observer files) or that the signal is either High or Low (when the observer does not file). In
particular, we will not be able to distinguish between the two circumstances that do not inspire
suit since all we will see is that the observer has not filed, not why. Contrast this to the situation
in the last paragraph where we learned precisely what signal was seen: with no filing we were
sure the signal was Low, while with filing we learned at the hearing whether the signal was
Medium or High. Thus in holding hearings for only one signal, we tie our hands in conditioning
the caretaker’s rewards and punishments: liability must be constant across the signals Medium
and High since we cannot distinguish between them.

In sum, and in general, reducing hearing attendance—by having either fewer circumstances
under which hearings are held or fewer attendees at each hearing that is held—coarsens the
principal’s information partition.

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5 This does not result in the lowest fixed costs, since Low is not the least likely signal outcome given care level 2,
but we will use what we find here in later paragraphs. The analysis is the same for either of the other signals.
The dotted arrow in Figure 3 shows the hearing advantage for care level 2 if we charge the caretaker $100 when the signal is either High or Medium. The vector is exactly collinear with the Low signal’s vector. This is no coincidence. It follows from the fact that the signal vectors derive from probability measures, which must add to one.\(^7\) We see from the diagram, then, that there is no linear combination of Low’s vector and the dotted vector that gets us into the dashed box. That is, there is no way of setting liability payments that causes care level 2’s hearing advantage to exceed its additional private costs. We have a shortfall in incentives here, represented graphically by the distance from the dashed box to the line including the Low signal’s vector. (The analysis is similar when we hold hearings for either one of the other two signals.)

Yet all is not lost for the one-signal hearing, because we still have another tool at our disposal: costly evidence production. It will in fact be possible to make up the shortfall in incentives identified in the last paragraph by reintroducing costly evidence production by the caretaker. In general terms, we will induce the observer to file suit if and only if he sees a Low signal. We will then impose a baseline level of liability on the caretaker just for the fact that suit was filed. This carries us part way down the Low signal’s vector in Figure 3. We will then impose additional liability on the caretaker if he fails to present evidence A at the hearing. This

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\(^6\) Notice that we are not requiring that liability is zero when there is no hearing; perhaps the state can tax the caretaker without holding a hearing. Since liability differences are all that matter, whether or not we restrict liability to be zero when there is no hearing is of no consequence to the problem.

\(^7\) The vector for Low is given by \((p_2^L - p_1^L, p_2^L - p_3^L)(-100)\), where the notation \(p_j^i\) is the probability of the signal \(j\) given care level \(i\). For High, \((p_2^H - p_1^H, p_2^H - p_3^H)(-100)\). Adding yields 
\[
(p_2^L + p_2^H - (p_1^L + p_1^H), p_2^L + p_2^H - (p_3^L + p_3^H))(-100),
\]
which, since \(p_1^H + p_1^L = 1 - p_1^M\) is the same as 
\[
-(p_2^M - p_1^M, p_2^M - p_3^M)(-100),
\]
the vector for Medium.
creates another incentive vector that we may add to the Low signal’s vector and if we have gotten the numbers right, this will carry us from the Low signal’s vector into the dashed box.

Here are the details: First, we rewrite the total hearing advantage for care level 2 in a more convenient form (definitions follow the equation):

\[
\begin{bmatrix}
V_2 - V_1 \\
V_2 - V_3
\end{bmatrix}
= \begin{bmatrix}
p^*_2 (-l_L + V_2) - p^*_1 (-l_L + V_1) \\
p^*_2 (-l_L + V_2) - p^*_3 (-l_L + V_3)
\end{bmatrix}
= -100 \left[ \frac{p^*_2 - p^*_1}{p^*_2 - p^*_3} \right] \left( \frac{-l_L + V_2}{-100} \right) + (p^*_1, p^*_3) \cdot \begin{bmatrix}
V_2 - V_1 \\
V_2 - V_3
\end{bmatrix}
\]  

(1)

Equation (1) says that the total expected hearing advantage for care level 2 \( \begin{bmatrix}
V_2 - V_1 \\
V_2 - V_3
\end{bmatrix} \), is the sum of: a) a scalar multiple, \( \frac{p^*_2 - p^*_1}{p^*_2 - p^*_3} \), of the Low vector \(-100 \left[ \frac{p^*_2 - p^*_1}{p^*_2 - p^*_3} \right] \left( \frac{-l_L + V_2}{-100} \right) \), and b) the hearing advantage of care level 2 from evidence production, conditional on holding a hearing \( \begin{bmatrix}
V_2 - V_1 \\
V_2 - V_3
\end{bmatrix} \), corrected (via dot product) by the probabilities \( (p^*_1, p^*_3) \). Some intuitive accounting is in order. We can think of \(-l_L + V_2\) as the baseline punishment for the caretaker that accrues simply by virtue of the fact that suit was filed against him. Part a) of the total hearing advantage of care level 2 relates to the lower probability that this punishment will be applied. The vector \( (p^*_1, p^*_3) \cdot \begin{bmatrix}
V_2 - V_1 \\
V_2 - V_3
\end{bmatrix} \), on the other hand, is the additional benefit that accrues to the agent when he takes care level 2, by virtue of differences in payoffs from costly evidence production, conditional on the hearing occurring.

Care level 2 has a hearing advantage over care level 1 in this regard because if the caretaker takes care level 1, there is a chance, \( p^*_1 \), that he will have to pay \( V_2 - V_1 \) more than the baseline
punishment \(-l_L + V_2\). (Perhaps some of this payment will be in the form of evidence costs.) A similar statement applies to care level 2 versus care level 3.

The values that can be created with the first addend \(-100 \left[ \frac{p^L_2 - p^L_1}{p^L_2 - p^L_3} \right] \left( -l_L + V_2 \right) \) all lie on the line containing the Low vector. To find all possible values of the second addend 

\( \left( p^L_1, p^L_3 \right) \cdot \begin{bmatrix} V_2 - V_1 \\ V_2 - V_3 \end{bmatrix} \), we modify Figure 2 by vector multiplying each possible hearing advantage in that figure by \( \left( p^L_1, p^L_3 \right) \). This yields Figure 4 in which the dark line represents all possible values of \( \begin{bmatrix} V_2 - V_1 \\ V_2 - V_3 \end{bmatrix} \) and the light line all possible values of \( \begin{bmatrix} V_2 - V_1 \\ V_2 - V_3 \end{bmatrix} \) as in Figure 2.

The vector \((30, -5)\) represents the expected hearing advantage from evidence production when all care levels are induced to present evidence A.

![Figure 4: Care Level 2's Hearing Advantage from Evidence Production](image-url)
We may then take this arrow and try to place it on the Low vector in Figure 3 in such manner that the two vectors, point to tail, take us into the dashed box. Finding the right point on the Low vector is the same as finding the right value of the baseline punishment \(-l_L + V_2\), which is the same as finding the right value of \(l_L\), since \(V_2\) is determined. If, in particular, we place the evidence production vector at the point (30, -45)—that is, we set \(-l_L + V_2 = -150 \iff l_L = 50\)—then we end up at \((30, -45) + (30, -5) = (60, -50)\), which is inside the dashed box. This is shown in Figure 5.

\[ V_2 - V_3 \]

\[
\begin{array}{c}
30 \\
40 \\
60
\end{array}
\]

\[ V_2 - V_1 \]

\(-45\)

\(-50\)

Figure 5: Implementing Care Level 2 with a Mixed System
We may now calculate the cost of implementing by the mixed system shown in Figure 5. Since we have hearings only when the signal is Low, expected fixed costs are \(0.4(2F) = 0.8F\). We add to this expected evidence production costs of \(0.4(100) = 40\), to give a total cost of \(0.8F + 40\).

What about the other ways to implement care level 2 with one-signal hearings? The reader can check that holding Low-signal hearings and then using a liability schedule in which care level 2 is induced to present evidence A is the only way to implement care level 2 with a one-signal hearing. In particular, none of the evidence production advantage vectors produceable with either High hearings or Medium hearings will be of a magnitude and direction that will enable us get us into the dashed box via combination with the respective signal vector. Thus, holding Low signal hearings in which care level 2 presents evidence A is the cheapest way to implement care level 2 under the constraint that we only hold hearings only for one signal.

Alternatively, the cheapest way to implement care level 2 holding hearings only for two signals has already been identified: we hold hearings when the signal is High or Medium and use no evidence production. Of course, holding hearings for all three signals is never optimal, since as we have seen, one signal is superfluous. Lastly, the cheapest way to implement with no-signal hearings, i.e. without using the second agent at all, was the first case we considered. Accounting for fixed costs, the cost of that implementation is \(100 + F\), which is never less than the cost of Low signal hearings \(0.8F + 40\).

Thus, in the overall contest for the cheapest way to implement care level 2, the only two contenders are Low signal hearings with evidence production, at a cost of \(0.8F + 40\), and High and Medium signal hearings with no evidence production at a cost of \(0.6(2F) = (1.2)F\). Which is cheapest depends on the size of fixed costs, i.e., the opportunity cost of attending the hearing for
the agents. The cost of each method is graphed against fixed costs in Figure 6, which makes clear that Low signal hearings with evidence production is the cheaper method when fixed costs are high. When fixed costs are high, it becomes worthwhile to hold fewer hearings and make up the incentive shortfall with costly evidence production.

![Graph showing implementation costs for different types of hearings.](image)

*Figure 6: The Minimal Cost Way to Implement Care Level 2 Depends on Fixed Costs*

2 **The Model**

The purpose of this section is to formally establish the trade-off between the fixed costs of attendance and the richness of opponent information. Thus, we model multiple parties and allow the possibility that suits are privately instigated. In particular, each agent may force a subset of agents to attend the hearing by naming them to the principal. The model we present is an extension of Sanchirico (1997), and the reader may wish to consult Section 1 of that paper before reading on.

The naming structure employed here is only as complicated as is necessary to identify our trade-off. For example, there will be only one hearing. In a more complex model the "joinder" of claims and parties would be part of the principal's constrained optimization.
In some ways, however, the structure here is quite general. For instance, there is no restriction that \( k \) name herself whenever she names others. (This characteristic of "plaintiffs" is, however, derived in the sequel.) Moreover, there is no structural distinction among named parties as between defendants and witnesses; this will turn on whether the party obliged to attend is also obliged to pay. Also, there is no restriction—typical of the literature—that suits arise from accidents; here (as in the real system, in fact) parties file when it is in their interest to do so. Whether that corresponds to the occurrence of an accident depends on their incentives.

There are \( K \) agents and each chooses an action \( i_k \in \{1,\ldots,I_k\} \), yielding an action profile \( i \in I = \prod_k \{1,\ldots,I_k\} \). As is standard in the law and economics of torts, we may think of some agents as (potential) injurers (e.g. drivers) and some as victims (e.g. pedestrians). The expected cost of accidents \( h \) is jointly determined by the care choice of all: whether the pedestrian is hit depends on both the driver's care in approaching the intersection and the pedestrian's care in crossing the street. The action profile stochastically determines the type profile \( j \in J = \prod_k \{1,\ldots,J_k\} \) at a subsequent hearing according to a commonly known probability measure. Thus, for all \( i' \in I \) (including the one we are implementing), we have

\[
P_r = (p(i')(j))_{j \in J}, \quad \text{where all } p(i')(j) \geq 0 \text{ and } \sum_{j \in J} p(i')(j) = 1.
\]

Joint care (action) choice affects what happens prior to the hearing and so also affects the "relevant" private information the agents bring to court.

### 2.1 Four Phases of the Model

The model has four phases. In the promulgation phase the principal announces the mechanism (defined below). In the second phase, the underlying activity, the agents
simultaneously choose their private actions, yielding an action profile $i' \in I$. Nature then determines a type profile $j \in J$ according to $P_r$. In the third phase, the filing phase, each agent $k$ decides whom to sue: this entails publicly naming a subset $N_k \subseteq K$ of agents. The court uses the power of the state to insure that agents $N_k$ do in fact attend the hearing. When $k$ names herself and $k'$, for instance, it is as if she has either filed suit against $k'$ or named $k'$ as a witness. The hearing takes place in the fourth and last phase.

This four phase model gives rise to three types of information sets/choice situations for the agents. Each agent chooses her action $i_k$ at an initial information set, $\emptyset_k$. After learning her type, she chooses whom to name. This occurs at a filing information set, $(i'_k, j_k)$. The last type of information set, the hearing information set, is determined by both $(i'_k, j_k)$ and by the pattern of filings produced by the agents' prior filing decisions.

We will need some cumbersome notation to keep track of these filing patterns. Denote the filing pattern/hearing resulting from agents' independent filing choices by the vector of subsets $N = (N_1, \ldots, N_K)$, where each $N_k \subseteq K$ and write $A_N = \bigcup_k N_k$ for attending agents. A hearing information set for $k$ is a triple $(N; i'_k, j_k)$ where $N$ satisfies $A_N \ni k$. At hearing information sets, agents decide what type to report (= what evidence to present). Each agent $k$ makes this choice cognizant of 1) what action $i'_k$ he took in the underlying activity, 2) his private signal $j_k$ of the joint action $i'$, and 3) which agents demanded the attendance of which other agents, as embodied in $N$.

2.2 The Mechanism
The principal’s mechanism prescribes 1) filing behavior as a function of own action and own signal (filing is done in private), and 2) hearing behavior—i.e. evidence production and liability—as a function of the joint signal. Formally, a mechanism is a tuple \((n,l,e)\) consisting of: 1) a filing (per type) schedule for each agent: \(n = (n_1, \ldots, n_K): J \rightarrow \binom{2^K}{K}\), with \(n_k: J_k \rightarrow 2^K\) for all \(k\) and 2) a liability (per evidence) schedule, one for each filing pattern, \(N\): i.e.,

\[(l,e) = \{ (l^N, e^N) \}, \text{ where } N \text{ ranges over the } 2^{2^K} \text{ possible filing patterns. These } (l^N, e^N) \text{ are complicated objects. For each filing pattern } N, (l^N, e^N) = \{ l^N_k, e^N_k \}_{k \in A_N}. \text{ Notice that } k \text{ here ranges over all agents } k \in A_N \text{ attending the hearing under that pattern. Then, for each filing pattern } N \text{ and each attending agent } k \in A_N, \text{ we have } l^N_k: J_{A_k} \rightarrow \Re, e^N_k: J_{A_k} \rightarrow E. \text{ (Note: as usual, for each } j \in J \text{ and each subset } S \subseteq K, j_S \text{ is the projection of } j \text{ onto the coordinates in } S).}\]

Implicit in the structure of \((l^N, e^N)\) are two restrictions. First only those agents attending hearing \(N\) attain non zero payoffs therefrom. Thus \((l^N, e^N) = \{ l^N_k, e^N_k \}\) ranges only over those \(k\) in \(A_N\). Second, liability and evidence in hearing \(N\) depends only on the types of agents attending \(N\). Thus \(e^N_k\) and \(l^N_k\) are functions defined on \(J_{A_k}\).

The first restriction is immaterial. The second is crucial. It implies that agent \(k\)'s private information can only be used to set her opponents' payoffs if \(k\) actually attends the hearing. This means that using \(k\)'s information about the joint action profile requires incurring the fixed costs for \(k\)'s attendance at the hearing. The idea is that relating one's private information does take time and resources (even though in this stylized model, the agent could simply identify a commonly accepted index number for her private information.)
2.3 Incentive Constraints

Suppose that we wish to induce the agents to jointly choose action profile \( i \). We implement \( i \) by iterated dominance. In particular, we backward induct through the three types of information sets just identified. First we require that truth-telling is optimal for each agent in the last phase, no matter what his beliefs about others’ behavior therein. Then we assume truth-telling in the last phase and require that it be weakly dominant in the next to last phase, etc... Thus each stage in the backward induction, and thus each phase of the model, has a separate incentive compatibility constraint.

First we require, unconditionally, that agents tell the truth at every possible hearing. Thus we first have a hearing constraint for each filing pattern/hearing:

\[
\forall N, k \in A_N, j_k, j'_k, j_{A_n - k}, \quad -I_k^N(j_{A_n}) - c_{j_k}(e_k^N(j_{A_n})) \geq -I_k^N(j'_k, j_{A_n - k}) - c_{j_k}(e_k^N(j'_k, j_{A_n - k})),
\]

where, if \( k \in S \), I write \( S - k \) for the set with \( k \) removed from \( S \).

Next is the filing constraint. Given truth-telling at every hearing, every agent files suit as specified in the mechanism (= “tells” true type at the filing stage) no matter what action profile \( i' \) she and others have taken and no matter how her opponents choose to file:

\[
\forall i', k, j_k, j'_k, j'_{-k}, \quad \sum_{j_{-k} \in J_{-k}} p(i')(j_{-k}|j_k)\nu_k^{N(i',i)}(j) \geq \sum_{j_{-k} \in J_{-k}} p(i')(j_{-k}|j_k)\nu_k^{N(i',i')}\nu_k^{N(i',j)}(j),
\]

where \( \forall k, N, \nu_k^N: J \rightarrow \mathbb{R} \) are \( k \)’s (truth-telling) payoffs for hearing \( N \), defined by

\[
\nu_k^N(j) = \begin{cases} 
-I_k^N(j_{A_n}) - c_{j_k}(e_k^N(j_{A_n})), & k \in A_N, \\
0, & k \notin A_N.
\end{cases}
\]

Lastly, the underlying activity constraint takes as given that agents file as specified in the mechanism and tell the truth at hearings:
\[ \forall k, i'_k, i'_{k}, \quad -a_k + \sum_{j \in \mathcal{J}} P(i_k, i'_k)(j)v^n_k(j)(j) \geq -a_k + \sum_{j \in \mathcal{J}} P(i_k', i'_{k})(j)v^n_k(j)(j) \]  

(4)

2.4 **The Principal’s Problem**

We divide the principal’s problem into two pieces. For any fixed action profile \( i \) the principal solves the cost minimization problem: 

\[
\min_{n, \epsilon, \delta} \sum_{i \in \mathcal{I}} p(i) \sum_{j \in \mathcal{J}} \sum_{k \in \mathcal{K}} e_k(j) \left( e_n(j) \left( j_{(i, j)} \right) \right),
\]

subject to (2)-(4). This yields for each action profile \( i \) a minimal implementation cost \( C_i \) (which will be infinite, when the profile is not implementable; and will always be zero for the profile that combines agents’ least privately costly actions.) Having calculated \( C_i \) for each \( i \), the principal solves his overall problem of deciding which action profile to implement:

\[
\min_{i} h_i + C_i.
\]

3 **Minimal Cost Implementation**

We fix an action profile \( i \) and study the problem of implementing it at minimal cost.

3.1 **Implementation with Zero Variable Costs**

We start by providing sufficient conditions for implementation at zero “variable costs”—i.e. with no evidence production. The basic idea is to have all types of all agents attend the hearing and to condition each \( k \) agent’s liability solely on her opponents’ reports. So long as all types of each agent are instructed to name the same subset of agents, the filing constraint is trivially satisfied. Moreover, since an agent’s report at the hearing has no bearing on his own payoffs, the hearing constraint is also satisfied. Thus, the problem here reduces to the familiar multiple agent moral hazard framework: all that remains is to be able to create the proper incentives in the
underlying activity by conditioning on opponent reports. This will be possible if opponent types
are a rich enough signal of own action.\textsuperscript{8}

We assume that an agent can always appear in court and present no evidence and that the
cost of doing so will not differ across type. In particular,

\textbf{Assumption 1}: \( \forall k, \exists e_k^0 \in E \) such that \( \forall j_k, c_{j_k}(e_k^0) = \min_{j_k \in A_k} c_{j_k}(e) \).

We may then write \( c_{j_k}(e_k^0) = F_k \) and call \( F_k \) the fixed cost of attendance for \( k \). Accordingly, we
call \( \zeta_{j_k}(e) = c_{j_k}(e) - F_k \), the variable cost to \( j_k \) of presenting \( e \). Purely for convenience, we also
assume that fixed costs are invariant across agents.

\textbf{Assumption 2}: \( F_k = F_k \), all \( k \).

Given \( n \), write \( A(j) = A_{n(j)} \) to save notation. Define for each mechanism \((n, l, e)\) and each
action profile \( i \), expected variable costs, \( V(i, n, l, e) = \sum_j p(i)(j) \sum_{k \in A(j)} \zeta_{j_k}(e_k^{n(j)}(j_{A(j)})) \) and
expected appearances, \( A(i, n, l, e) = \sum_{j \in A} p(i)(j) |A(j)| \), where \( |S| \) denotes the number of agents in
\( S \subseteq K \).

Letting \( P_k \) be the \( I \times J_{-k} \) matrix with elements \( p(i)(j_{-k}) = \sum_{j \in A_k} p(i)(j', j_{-k}) \), we have

\textbf{Theorem 1}. If all \( P_k \) have full row rank, then all \( i \) are implementable at zero variable cost.

\textsuperscript{8} It is also possible to implement with strict incentives at arbitrarily low variable costs.
Proof: Restrict attention to mechanisms in which every type of every agent names the same subset and the result is that all agents attend. The filing constraint is then trivially satisfied and we may drop the superscript \( N \), proceeding as if there were no filing stage.

Take any \( i \). For all \( k \), set \( e_k(j) = e_k^0 \) all \( j \) and restrict attention to liability schedules contingent only on opponent reports \( j_{-k} \), which may be written as \( (l_k(j_{-k}))_{j_{-k} \in J_{-k}} \). Any such liability per evidence schedule satisfies (2)-(4) for \( k \), if we can find \( (l_k(j_{-k}))_{j_{-k}} \) s.t.

\[
\forall i'_k \in I_k, \forall i'_{-k} \in I_{-k}, -\sum_{j_{-k} \in J_{-k}} \left( p(i_k, i'_{k})(j_{-k}) - p(i'_k, i'_{-k})(j_{-k}) \right) l_k(j_{-k}) \geq a_{i_k} - a_{i'_k}. \quad \text{(The } F_k \text{'s drop out.) By standard linear algebra arguments, this system of } I \text{ equations in } J_{-k} \text{ unknowns has a solution if } P_k \text{ has full row rank.)}
\]

**Budget Balance and "Decoupling."** Adding a constant to \( (l_k(j_{-k}))_{j_{-k}} \) affects neither (2) nor (4). Consequently, the theorem holds even if we impose a system wide expected budget balance constraint on liability payments: \( \sum_{j \in J} p(i)(j) \sum_{k=1}^K l_k(j_{-k}) \leq (\text{or }=) 0 \). Budget balance for each \( j \), however, adds \( J \) additional constraints to the full system—\( \forall j, \sum_{k} l_k(j_{-k}) \leq (\text{ or } =) 0 \). This yields in total \( K(I - 1) + J \) inequalities in \( \sum_{k=1}^K J_{-k} \) unknowns in the proof of the theorem and the full row rank of each \( P_k \) will not be sufficient for the full row rank of this system. The fact that case by case balance restricts use of the mechanic at work in THEOREM 1 is yet another argument for "decoupling" plaintiff recovery from defendant liability. (See, Polinsky and Che [1991] for other arguments).
3.2 **Minimal Cost Implementation with Fixed Costs of Attendance**

The mechanism in the previous subsection need not be optimal because it is designed to minimize only variable and not total costs. *Theorem 2* concerns the total picture. It shows that the higher are fixed costs, the fewer are expected appearances and the higher are variable costs in the optimal mechanism. Fewer expected appearances means that fewer agents are named in fewer circumstances. Higher variable costs means that more expensive evidence is presented by more agents under more circumstances. In particular, the theorem identifies four regions of fixed costs. At zero fixed costs, the court cares nothing about the number of appearances *per se* and instead minimizes variable costs. In particular, if the full rank condition holds, then we know from the previous section that variable costs will be minimized at zero.

For positive fixed costs the court *does* care about the number of appearances: all else the same, it would like to minimize the number. Thus, it will certainly never induce more appearances than are necessary to implement at zero variable cost. However, if we attempt to lower expected appearances to just below the minimum necessary to implement at zero variable cost, our incentive shortfall will be discreet, and thus the costly signaling needed to make up the shortfall in incentives will be strictly positive. (This is shown in the proof.) For sufficiently small fixed costs, this tradeoff will not be worthwhile, and so there will be a second region wherein expected variable costs are zero and appearances are kept to a minimum given this. It is suggested that this region corresponds to the early common-law system as discussed in the introduction. Once fixed costs are no longer sufficiently small, it is optimal to institute costly signaling while cutting back on appearances. And when fixed costs become sufficiently large,
we will use the mechanism that implements $i$ with the minimum number of appearances, without regard to variable costs.

**THEOREM 2:** Suppose $(n, l, e)$ and $(n', l', e')$ implement $i$ at minimal cost with fixed costs $F$ and $F' > F$, respectively. Write $V = V(i, n, l, e)$, $A = A(i, n, l, e)$, $V' = V(i, n', l', e')$, etc... Then

**Monotonicity**

i) $V \leq V'$ and $A \leq A'$, i.e., expected variable (evidence) costs are higher and expected attendance is lower at an optimum for higher fixed costs.

ii) If either $(n, l, e)$ or $(n', l', e')$ is not a least cost implementation given the other's fixed costs, then $V < V'$ and $A' < A$.

**Endpoints**

iii) If $F = 0$, then $(n, l, e)$ minimizes expected variable costs $V$ among all mechanisms implementing $i$.

iv) If $F$ is sufficiently small positive and all $P_k$ have full row rank, then $(n, l, e)$ minimizes expected appearances $A$ among all mechanisms implementing $i$ with zero expected variable costs, $V = 0$.

v) If $F$ is sufficiently large, then $(n, l, e)$ minimizes expected appearance $A$ among all mechanisms implementing $i$.

The proof uses the following lemma. The lemma concerns the problem of implementing a given level of care at minimal cost with the added constraint that the filing pattern be set at some pre-specified $n$. The lemma establishes the sense in which the solution to this problem is invariant to the size fixed costs. As a preliminary matter, note that it is not true that if a liability schedule
\((l,e)\) solves the problem with fixed costs \(F\), then it also solves the problem with fixed costs \(F'\). The schedule \((l,e)\) may not even be incentive compatible in the filing stage. If for example we raise fixed costs, the increased cost of attendance may induce some agents to change their filing behavior in some circumstances. The simplest case is where we intend for agent/type \(j_k\) to name himself (and possibly others) and there is some chance of his being decisive in his own attendance because there is at least one opponent type profile \(j_{-k}\) where no others name \(k\). With higher fixed costs \(j_k\) may decline to name himself in order to avoid attendance costs in the circumstance where he is decisive. However, as the lemma establishes, the evidence schedule, taken by itself, will still be optimal. If evidence schedule \(e\) solves the attendance-constrained cost minimization problem in conjunction with some liability schedule \(l\) when fixed costs are \(F\), then it also solves the problem in conjunction with some other liability schedule when fixed cost are \(F'\) The new liability schedule compensates (charges) attending agents for the increased (decreased) cost of attendance by reducing (increasing) liability across the board.

Lemma 1: Let \(V(n)\) be the minimal variable cost of implementing \(i\) when the filing portion of the mechanism is constrained to be \(n:J \rightarrow (2^k)^K\). \(V(n)\) is independent of \(F\).

Proof: I first claim that if \(n\) and \(e\) implement \(i\), with some \(l\), when fixed costs are \(F\), then \(n\) and \(e\) implement \(i\) with some \(l'\) for \(F'\). Set \(l' = l + F - F'\). This translation affects neither compliance with the hearing incentive constraint, nor the \(v^N_k\) schedules: if \(k\) does not attend hearing \(N\), then \(v^N_k\) is still zero; if \(k\) does attend \(N\), then the new \(v^N_k(j)\) is

\[-(l^N_k(j_{A_k}) + F - F') - (\xi_{j_k}(e^N_k(j_{A_k})) + F') = -(l^N_k(j_{A_k})) - (\xi_{j_k}(e^N_k(j_{A_k})) + F')\]. Since, the \(v^N_k\)
schedules are unchanged, the filing and underlying activity constraints are still satisfied. Thus, as preliminarily claimed, the set of $e$ implementing $i$ with some $l$, when the filing pattern is fixed at $n$, is invariant with respect to $F$. Thus $(N,e,l')$ implements $i$ when fixed costs are $F'$. Since the court’s objective, as a function of $(l,e)$—with $n$ fixed—is merely translated by changes in $F$, a solution for $F$ is as well a solution for $F'$ and so $V(n)$ is invariant with respect to $F$, as first claimed.

Proof of Theorem:

First consider $i)$. Letting $A(n) = \sum_{j \in J} p(i)(j)A(j)$, optimality of $(n,l,e)$ for $F$ implies

$$V(n) + FA(n) \leq V(n') + FA(n').$$

Similarly, $V(n') + F'A(n') \leq V(n) + F'A(n)$. Combining yields,

$$(F - F')(A(n) - A(n')) \leq 0.$$ Since $F < F'$, we have $A(n) \geq A(n')$. Substituting yields

$$V(n') \geq V(n).$$

For $ii)$ note that if $V(n') + F' A(n') < V(n') + FA(n')$ or $V(n') + F'A(n') < V(n) + F'A(n)$, then $A(n) > A(n')$ and so $V(n') > V(n)$. Part $iii)$ is immediate. For $iv)$ recall that if $Ax \geq b$ has no solution then for all $\epsilon$ small enough, $Ax \geq b - \epsilon$ also has no solution. Therefore, if for some $n$, the three sets of constraints, taken as a linear system, in $l$ and evidence costs $\{c_{jh}(e^{v}_{k}(j))\}_{k,j,n'}$, has no solution when we constrain all $c_{jh}(e^{v}_{k}(j))$ to be $c_{jh}(e_{0})$, then creating a solution by relaxing this constraint must involve a discreet increase in some $c_{jh}(e^{v}_{k}(j))$, and thus a discreet increase in variable costs. For small enough fixed costs, this increase in variable costs will exceed any reduction in fixed costs caused by reducing appearances. To see that $(n,l,e)$ minimizes appearances for large enough $F$, as claimed in $v)$,
suppose, on the contrary that there is a filing mechanism \( n'' \) with strictly smaller expected appearances, \( A(n) > A(n'') \) under which \( i \) is also implementable with some \((l,e)\). Then the additional cost of implementing \( i \) with \( n'' \) would be \( V(n'') + FA(n'') - (V(n) + FA(n)) = (V(n'') - V(n)) - F(A(n) - A(n'')) \). For large enough \( F \), this is negative, contradicting the optimality of \((n,l,e)\). ■

**Budget Balance.** Because of the additional filing constraint, system wide budget balance is not attainable by simple translation, as in the previous section. Nevertheless, the results in this section remain intact, so long as we redefine "implement" to include budget balance. The same is true of case by case balance, with the additional caveat that with respect to part iv of Theorem 2, the full rank condition is no longer sufficient for zero variable cost implementation.

**Randomized Attendance.** If we allow the court to randomize attendance, then no matter how large fixed costs, the court can enforce care at arbitrarily low total cost, so long as all \( P_k \) have full row rank: starting with the zero variable cost solution of the previous section, which involves only transfers and no evidence production, the court can create the same incentives if the parties come to court with independent probability \( \frac{1}{n} \), so long as it multiplies transfers by \( n \). This assumes, of course, that there is no bound on transfers. Fully incorporating random mechanisms would require investigating the implications of such restrictions, an exercise beyond the scope of this paper. It is interesting to note, however, that random attendance, though it lowers fixed costs, does not involve the same loss of information, and thus does not create the same trade-off, as selected private instigation.
3.3 The Role of "Plaintiff"

The object of introducing this model is to rationalize the current system’s mix of evidence production and adversarial dynamics. But the general framework we have introduced may be used to explain many other characteristics of the current system that are often taken for granted. The following result deriving certain aspects of the plaintiff’s role, is included to give some indication of what is possible. It is shown that under certain plausible assumptions, whenever an agent names another to appear in court, she too will appear along with the agent she has named. Moreover her incentive in instigating this portion of the suit will be her expectation that doing so will increase her hearing payoffs.

Filing incentives are effectively strict in \((n,l,e)\), if (3) holds with strict inequality whenever

\[ A(j) \neq A(j', j_{-k}) \]

Thus if, when her opponents name \(n_{-k}(j_{-k})\), \(k\)'s choice of whom to name as between \(n_k(j_k)\) and \(n_k(j'_k)\) is decisive for who appears, then \(k\)'s incentive to name \(n_k(j_k)\) over \(n_k(j'_k)\) when she is of type \(j_k\) and her opponents file as \(n_{-k}(j_{-k})\), is strict. The following result says that if there is at least one type of every agent that does not file, then agents must always include themselves in their list of who should attend, if incentives to be effectively strict.

**Theorem 3:** If \((n,l,e)\) has effectively strict filing incentives and for all \(k'\) there is some \(j_k\), where \(n_k(j_k) = \emptyset\), then \(n_k(j'_k) \neq \emptyset\) implies \(n_k(j'_k) \supset k\).

Proof: I prove the theorem for a weaker definition of effective strictness wherein

"\(A(j) - k \neq A(j'_k, j_{-k}) - k\)" replaces "\(A(j) \neq A(j'_k, j_{-k})\)." Suppose \(n(j) = \emptyset\). (\(j\)'s existence is guaranteed by assumption and the rectangular structure of \(n\).) Suppose \(k \notin n_k(j'_k) = \emptyset\). Then
$A(j) - k \neq A(j', j_{-k}) - k$ and so by assumption $k$ strictly prefers $n_k(j'_k)$ to $n_k(j_k)$ when she's of type $j_k$ and her opponents file $n_{-k}(j_{-k})$. But $k$ has zero hearing payoffs at $n(j)$ since she does not appear (nor does anyone else). Therefore, she gets strictly positive payoffs when she names $n_k(j'_k)$, is of type $j'_k$ and others name $n_{-k}(j_{-k})$. This is only possible if she appears at $n(j)$.

Since $n_{-k}(j_{-k}) = \emptyset$, $n_k(j'_k) \ni k$, a contradiction.

### 3.4 WHICH ACTION TO IMPLEMENT

In a previous section we examined how changes in the fixed costs of attendance affected the optimal appearances and own-evidence production in the implementation of a particular action. In this section we allow the implemented action to vary as well.

We find that the trade-off remains essentially intact with one new qualification. As stated formally in the following theorem, when fixed costs increase, the optimal number of appearances will still decline, regardless of changes in the action implemented. In the previous section, where the implemented action was fixed, this necessitated an increase in own evidence production to take up the slack, as it were. Here, there are two things that can “give”: own evidence production, as before, or the “quality” of the action implemented. Accordingly, we observe that increased fixed costs and attendant decline in appearances are met with either an increase in own evidence production or a decrease in the quality of the action implemented—“quality decrease” in the precise sense that the new action’s first best costs (precaution plus expected harm) are higher.
Theorem 4: Suppose that the mechanisms \((i,n,l,e)\) and \((i',n',l',e')\) are optimal (solve the principal's overall problem) with fixed costs \(F\) and \(F' > F\) respectively. Write \(A = A(i,n,l,e)\), \(V = V(i,n,l,e)\), \(A' = A(i',n',l',e')\), etc... Then \(A \geq A'\) and \(a_i + h_i + V \leq a_{i'} + h_{i'} + V'\). Thus, optimal appearances decline in fixed costs while the sum of expected harm and expected own evidence costs (and thus at least one of these) increases.

Proof: Given \(\bar{F}\) and \(\bar{i}\), let \(A(\bar{F},\bar{i})\) and \(V(\bar{F},\bar{i})\) be appearances and variable costs in some minimal cost implementation of \(\bar{i}\). First we show \(A \geq A'\). The following succession of inequalities is justified below. What changes from line to line is pointed out with arrows.

\[
(F' - F)A = (F' - F)A(F,i) = [F'A(F,i) + V(F,i)] - [FA(F,i) + V(F,i)]
\]

\[
\geq [F'A(F',i') + V(F',i')] - [FA(F,i) + V(F,i)]
\]

\[
\geq [F'A(F',i') + V(F',i')] - [FA(F',i') + V(F',i')]
\]

\[
\geq [F'A(F',i') + V(F',i')] - [FA(F',i') + V(F',i')] = (F' - F)A(F',i') = (F' - F)A'
\]

The move from (5) to (6) follows from the fact that, given \(F'\), \(A(F',i)\) and \(V(F',i)\) correspond to a minimal cost implementation of \(i\). (This step involves comparison with \(A(F,i)\) and \(V(F,i)\), and so Lemma 1 is needed to establish that when fixed costs are \(F'\), action \(i\) can indeed be implemented with a mechanism having appearances \(A(F,i)\) and variable costs \(V(F,i)\).) A similar argument, for \(F'\) and \(i'\) justifies (7) to (8). Finally, (6) to (7) follows from the fact that action \(i'\) is optimal with \(F'\) while action \(i\) is optimal with \(F\). In particular,

\[
a_i + h_i + F'A(F',i) + V(F',i) \geq a_{i'} + h_{i'} + F'A(F',i') + V(F',i').
\]
\[ a_i + h_i + FA(F, i) + V(F, i) \leq a_{i'} + h_{i'} + FA(F, i') + V(F, i'). \]  \hspace{1cm} (10)

Subtraction of these inequalities yields precisely (6) \( \geq \) (7).

To obtain \( a_i + h_i + V \leq a_{i'} + h_{i'} + V' \) and complete the proof, start by combining (10) with the fact that \( FA(F, i') + V(F, i') \) is the minimal cost of implementing \( i' \):

\[ a_i + h_i + FA(F, i) + V(F, i) \leq a_{i'} + h_{i'} + V(F, i'). \]

Applying the result in the previous paragraph—\( A(F, i) = A \geq A' = A(F', i') \)—yields

\[ a_i + h_i + V = a_i + h_i + V(F, i) \leq a_{i'} + h_{i'} + V(F', i') = h_{i'} + V'. \]
4 References


(Superceded by this paper and Sanchirico [1997])


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