Law And Economics

Tort Law: Bilateral Care

Francisco Poggi

University of Mannheim - Fall 2021

The Bilateral Care Model

Summary

- When victims can take precautions, strict liability does not implement efficient care.
  - Does not provide incentives for the victim to take precautions.
- In fact, when victims can take precautions, the model is almost *symmetric*.
  - NL and SL are two extreme cases of constant liability. No constant liability rule can implement the first-best.
- Negligence rule works because it plays a dual role:
  - Injurer takes care to avoid liability.
  - Victim takes care because is liable in equilibrium.

The Bilateral Care Model

- x: investment in precaution by injurer.
- y: investment in precaution by the victim.
- a: accident in {0,1}
- $p(x, y) := \Pr(a = 1|x, y)$. Probability of accident.
- D: dollar losses suffered by the victim.
- Let $D(x, y) = E_{x,y}[D|a = 1]$

Example: Hunters and Joggers

- Hunter chooses precautions:
  - clear shot,
  - how far from the road, etc.
- Jogger chooses precautions:
  - Wear orange vest.
  - Not go far from main roads, etc.

Probability of Accident

- We assume diminishing returns: $p_{yy} > 0$ and $p_{xx} > 0$.

Definition

Precautions are *strategic substitutes* if $p_{xy} > 0$

Definition

Precautions are *strategic complements* if $p_{xy} < 0$

Social Problem

$$\min_{x,y} \quad E_{x,y}[x + y + aD] \quad = \quad \min_{x,y} \quad x + y + p(x,y) \cdot D(x,y)$$

- Let the (unique, interior) solution to this problem be (x^*, y^*).
- FOC:

$$1 + p_x(x^*, y^*)D(x^*, y^*) + p(x^*, y^*)D_x(x^*, y^*) = 0$$
$$1 + p_y(x^*, y^*)D(x^*, y^*) + p(x^*, y^*)D_y(x^*, y^*) = 0$$

- To simplify analysis: deterministic damage D (given accident).

Decentralized Problem

- Problem of the injurer:

$$\min_{x} \quad x + p(x, y) \cdot \psi$$

- Problem of the victim:

$$\min_{y} \quad y + p(x, y) \cdot (D - \psi)$$

- Equilibrium will depend on the liability rule $\psi(x, y)$.

Implementation

Definition

We say that a Liability Rule ψ *implements* a level of care (x, y) if (x, y) is an equilibrium given ψ.

No Liability

$\psi(x, y) = 0$

- The injurer chooses $\hat{x} = 0$.
- Given this, the Victim's problem is:

$$\min_{y} \quad y + p(x, y) \cdot D$$

- FOC:

$$1 + p_y(0, y) \cdot D = 0$$

- Notice that:

$$p_y(0, \hat{y}) = -\frac{1}{D} = p_y(x^*, y^*)$$

- When precautions are strategic complements, $p_y(x^*, \hat{y}) < p_y(0, \hat{y}) = p_y(x^*, y^*)$
- So, $\hat{y} < y^*$.

Strict Liability

$\psi(x, y) = D$

- The victim chooses $\hat{y} = 0$.
- Given this, the Injurer's problem is:

$$\min_{x} \quad x + p(x, 0) \cdot D$$

- The first order condition is:

$$1 + p_x(x, 0)D = 0$$

General Constant Liability

Claim

There is no constant ψ that achieves efficiency.

- For the injurer to be efficiently careful, his cost from the accident ψ should be equal to D.
- For the victim to be efficiently careful, the same is true: $D - \psi = D$.

What if what the injurer pays is not transferred to the victim?

Strict Liability Without Victim Compensation

$\psi^I = D$, $\psi^V = 0$.

- Problem of the injurer:

$$\min_{x} \quad x + p(x, y) \cdot D$$

- Problem of the victim:

$$\min_{y} \quad y + p(x, y) \cdot (D - 0)$$

Negligence

$$\psi(x, y, D) = 1_{\{x<\bar{x}\}} \cdot D$$

- This rule achieves efficiency.

Contributory Negligence

- Negligence Rule focuses on precautions taken by the Injurer.
- Contributory Negligence focuses on the precautions taken by the Victim.

  - Negligence with Contributory Negligence:

$$\psi(x, y, D) = 1_{x<\bar{x}} \cdot 1_{\{y \geq \bar{y}\}} \cdot D.$$

  - Strict Liability with Contributory Negligence:

$$\psi(x, y, D) = 1_{\{y \geq \bar{y}\}} \cdot D.$$

Negligence with Contributory Negligence

$$\psi(x, y) = 1_{x<\bar{x}} \cdot 1_{\{y \geq \bar{y}\}} \cdot D.$$

- We want to show that (x^*, y^*) is a NE when thresholds are optimal $\bar{x} = x^*$ and $\bar{y} = y^*$.
  - Fixing y^*, the problem of the injurer is:

$$\min_{x} \quad x + p(x, y^*) \cdot \underbrace{\psi(x, y^*, D)}_{1_{\{x<x^*\}} \cdot D}$$

    - Looks like Negligence. Best response is x^*.
  - Fixing x^*, the problem of the victim is:

$$\min_{y} \quad y + p(x^*, y) \cdot [D - \underbrace{\psi(x^*, y, D)}_{0}]$$

    - Looks like No Liability. Best response is y^*.

Strict Liability with Contributory Negligence

$$\psi(x, y) = 1_{x<\bar{x}} \cdot 1_{\{y \geq \bar{y}\}} \cdot D.$$

- (x^*, y^*) is a NE.
  - Fixing y^*, the problem of the injurer is:

    $$\min_x \quad x + p(x, y^*) \cdot \underbrace{\psi(x, y^*, D)}_{D}$$

    - Looks like Strict Liability. Best response is x^*.
  - Fixing x^*, the problem of the victim is:

    $$\min_y \quad y + p(x^*, y) \cdot [D - \underbrace{\psi(x^*, y, D)}_{1_{\{y<y^*\}} \cdot D}]$$

    - Looks like the problem of the injurer under Negligence. Best response is y^*.

Advantages of Contributory Negligence

- When both parties choose care simultaneously, in equilibrium, they act as if the other party was behaving optimally.
- Deviations don't change the actions of the other party.
- When parties choose care in sequence, deviations might affect the incentives for the other party to perform due care.
- The advantage of Contributory Negligence is *off the equilibrium path* in sequential care.

Sequential Care

Sequential Care

- Agents choose care in sequence. Second mover observes level of care by the first mover.
- Any liability rule that implements efficiency for simultaneous decision will do so for sequential ones.
- For simultaneous decisions, we wanted that the efficient care is an equilibrium outcome of the game.
- Now we want a stronger condition to be satisfied: efficient care on and off the equilibrium path.
- Two cases:
    - Injurer moves first.
    - Victim moves first.

Injurer Moves First

- The efficient thing to do is, in general, not y^*. Let $y^*(x)$ be the *social best response*. I.e., the solution to

$$\min_y \quad y + p(x, y) \cdot D$$

- If victim observes that the injurer didn't meet $(x < x^*)$ the due standard, the problem becomes:

$$\min_y \quad y + p(x, y) \cdot (D - \psi(x, y))$$

- Let $\tilde{y}(x)$ and $\tilde{x}(y)$ the best response functions.

Activity Levels

Bilateral Care with Activity Level

- x: investment in precaution by injurer.
- $q \in [0, 1]$: activity level of injurer.
- y: investment in precaution by the victim.
- $r \in [0, 1]$: activity level of the victim.
- a: accident in {0,1}
- $q \cdot r \cdot p(x, y) := \Pr(a = 1|x, y, q, r)$. Probability of accident.
- D: deterministic dollar losses suffered by the victim in case of accident.

Example: Hunters and Joggers

- Both hunter and jogger choose activity level
  - Frequency interpretation.
  - Heterogeneity interpretation.

Social Problem

$$\max_{x,y,q,r} \quad u(q) + v(r) - x - y - q \cdot r \cdot p(x,y) \cdot D$$

- FOC:
  - $[q]$: $\qquad u'(q^*) - r^* \cdot p(x^*, y^*) \cdot D = 0$
  - $[r]$: $\qquad v'(r^*) - q^* \cdot p(x^*, y^*) \cdot D = 0$
  - $[x]$: $\qquad 1 - q^* \cdot r^* \cdot p_x(x^*, y^*) \cdot D = 0$
  - $[y]$: $\qquad 1 - q^* \cdot r^* \cdot p_y(x^*, y^*) \cdot D = 0$

Observability

- Like before, we assume that Liability Rule can depend on (x, y), but not on (q, r).
- With the frequency interpretation, this might be due to impossibility to observe frequency.
- What about the heterogeneity interpretation?

Impossibility of Implementing the First Best

Claim

There is no liability rule that implements the efficient levels of care and activity.

- If $\psi(x^*, y^*) < D$, the injurer would take an inefficiently high level of activity.
- If $\psi(x^*, y^*) > 0$, the victim would take an inefficiently high level of activity.

Combination of Liability and Pigouvian Taxes

Efficiency can recovered if liability is combined with other tools that affect incentives.

- For example, a negligence rule with a Pigovian tax for the injurers.
- If injurer takes due precautions and actions, victim does it too because faces internalizes all costs in equilibrium.
- Injurer takes due precautions to avoid liability (negligence).
- How can we ensure the injurer chooses the right activity level?

Combination of Liability and Pigouvian Taxes

- Problem of the injurer (given optimal precautions x^*)

$$\max_q \qquad u(q) - q[x^* + \tau]$$

- Setting $\tau = p(x^*, y^*)D$ recovers efficiency!

  - How we concile the fact that activity level cannot be incorporated in the liability function, but we can charge a tax?

Cause-in-Fact

Negligence with Cause-in-Fact

- Golf driving range next to a parking lot.
  - x height of the safe net.
  - $z \sim F$ height of the ball. (given, support in $[0, 1]$).
  - D damage caused if $z > x$ (deterministic).

Negligence with Cause-in-Fact

- Cost of the net is $c(x)$.
- Efficient net size solves:

$$\min_{x} \quad c(x) + \underbrace{P(z > x)}_{(1-F(x))} \cdot D$$

- Solution x^*.

Negligence with Cause-in-Fact

- **Cause-in-fact**: injurer is only liable if damage would not have happend had he taken due precautions.
- In terms of the model: liability is a function of z instead of x.

$$\psi(z, D) = 1_{\{z<\bar{x}\}} \cdot D$$

- Consider optimal threshold $\bar{x} = x^*$.
- This rule implements efficient care.

Negligence with Cause-in-Fact

- Problem of the injurer:

$$\min_{x} \quad c(x) + \underbrace{\Pr(z \in (x, x^*))}_{(F(x^*)-F(x))} \cdot D$$

- Solution: x^*.

Negligence with Cause-in-Fact

- Like Negligence, Negligence with Cause-in-Fact implements the efficient care.
- Advantages over negligence?
  1. The cost function for the injurer is continuous.
- Negligence with Cause-in-Fact is arguably more costly to implement (at least in the example).