Injurer of Victim?

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Injurer of Victim? I

Changed Notations:

$$D = L \ \& \ \pi(x, y) = p(x, y)$$

Assume:

- There are two parties; X and Y
- L is constant (for simplicity)
- $p_x(x, y) < 0$, $p_{xx}(x, y) > 0$, $p_y(x, y) < 0$, $p_{yy}(x, y) > 0$, and so on
- In an accident, there is only one victim. However,
- X can be either the Victim or the Injurer. Similarly, Y can be either the Victim or the Injurer.

Injurer of Victim? II

(x^*, y^*) uniquely solves the SOP

$$min_{x,y}\{x + y + p(x, y)L\}$$

Let

- α be the subjective probability that X will be the victim; $0 \leq \alpha \leq 1$
- β be the subjective probability that Y will be the victim; $0 \leq \beta \leq 1$

- If the beliefs are coordinated or consistent, then $\alpha + \beta = 1$
- If the beliefs are NOT coordinated or are inconsistent, then in general $\alpha + \beta \neq 1$

Standard Liability Rules I

The standard negligence liability rules are such that

$$\begin{array}{lcl} x \geq x^* \ \& \ y \geq y^* & \Rightarrow & \text{victim pays/not compensated} \\ x < x^* \ \& \ y \geq y^* & \Rightarrow & X \text{ pays/not compensated} \\ x \geq x^* \ \& \ y < y^* & \Rightarrow & Y \text{ pays/not compensated} \end{array}$$

Let

C_X denote the total **accident** costs for X
C_Y denote the total **accident** costs for Y

Standard Liability Rules II

So, under any of the standard negligence liability rules, the following holds:

$$x \geq x^* \;\&\; y \geq y^* \quad \Rightarrow \quad C_X = x + \alpha p(x,y)L \tag{0.1}$$

$$x < x^* \;\&\; y \geq y^* \quad \Rightarrow \quad C_X = x + p(x,y)L \tag{0.2}$$

$$x \geq x^* \;\&\; y < y^* \quad \Rightarrow \quad C_X = x \tag{0.3}$$

Under any of standard liability rules the following will hold:

Proposition

(x^*, y^*) is a N.E.

Moreover,

Proposition

If $(\tilde{x}, \tilde{y})$ is a N.E., then: $\tilde{x} \leq x^*$, and $\tilde{y} \leq y^*$.

Rule of Negligence I

Under the Rule of (simple) Negligence:

$$x < x^* \;\&\; y < y^* \quad \Rightarrow \quad C_X = x + (1-\alpha)p(x,y)L$$

$$x < x^* \;\&\; y < y^* \quad \Rightarrow \quad C_Y = y + (1-\beta)p(x,y)L$$

Question

Consider $(\tilde{x}, \tilde{y})$ such that $\tilde{x} < x^*$ & $\tilde{y} < y^*$. Can $(\tilde{x}, \tilde{y})$ be a N.E.

For $(\tilde{x}, \tilde{y})$ to be a N.E., the following must hold:

$$\begin{aligned} \tilde{x} + (1-\alpha)p(\tilde{x},\tilde{y})L &\leq x^* \\ \tilde{y} + (1-\beta)p(\tilde{x},\tilde{y})L &\leq y^* \end{aligned}$$

Rule of Negligence II

that is,

$$\begin{aligned} \tilde{x} + \tilde{y} + (1-\alpha)p(\tilde{x},\tilde{y})L + (1-\beta)p(\tilde{x},\tilde{y})L &\leq x^* + y^* \\ &< \tilde{x} + \tilde{y} + p(\tilde{x},\tilde{y})L, \textit{i.e.}, \end{aligned}$$

$$1 < \alpha + \beta$$

Proposition

Under the Rule of Negligence, $(\tilde{x},\tilde{y})$ such that $\tilde{x} < x^*$ & $\tilde{y} < y^*$ can be a N.E. only if $\alpha + \beta > 1$.

Rule of Contributory Negligence I

Under the Rule of Negligence with Defense of Contributory Negligence:

$$x < x^* \ \& \ y < y^* \quad \Rightarrow \quad C_X = x + \alpha p(x, y) L$$

Proposition

Under the Rule of Contributory Negligence, $(\tilde{x}, \tilde{y})$ such that $\tilde{x} < x^*$ & $\tilde{y} < y^*$ can be a N.E. only if $1 > \alpha + \beta$.

Rule of Comparative Negligence I

Under the Rule of Comparative Negligence:

$$x < x^* \ \& \ y < y^* \quad \Rightarrow \quad C_X = x + \frac{x^* - x}{(x^* - x) + (y^* - y)} p(x, y) L$$

Proposition

Under the Rule of Comparative Negligence, for any given $0 \leq \alpha, \beta \leq 1$, $(\tilde{x}, \tilde{y})$ *such that* $\tilde{x} < x^*$ & $\tilde{y} < y^*$ *CANNOT be a N.E.*

Small Car or SUV? I

Let

- s denote the 'size' of vehicle owned by X; $s \in [0, \infty)$
- t denote the 'size' of vehicle owned by Y; $t \in [0, \infty)$
- r be the price-rate (per-unit of size) of vehicles

Let,

- $\bar{\alpha}(s, t)$ be the (objective) probability that X will be the victim; $\bar{\alpha} = \frac{t}{s+t}$
- $\bar{\beta}(s, t)$ be the (objective) probability that X will be the victim; $\bar{\beta} = \frac{s}{s+t}$

Small Car or SUV? II

Assume $\bar{\alpha}(0,0) = \frac{1}{2} = \bar{\beta}(0,0)$.

Now, for any given t and y, total costs of X are

$$x + \text{expected accident (liability) costs} + \text{ costs of vehicle size}$$

$$x + \text{expected accident (liability) costs} + sr$$

Under any of standard liability rules the following will hold:

Proposition

In equilibrium, X and Y will choose x^* and y^*, respectively.

As to the choice of vehicle size, in equilibrium:
X solves

$$min_s\{C_X + rs = x^* + \frac{t}{s+t}p(x^*, y^*)L + rs\}$$

So, we get

Small Car or SUV? III

$$s = \left(\frac{t}{r}p(x^*, y^*)L\right)^{\frac{1}{2}} - t$$

Similarly, Y solves

$$min_t\{C_Y + rt = y^* + \frac{s}{s+t}p(x^*, y^*)L + rt\}$$

In equilibrium, we get we get

$$\bar{s} = \bar{t} = \frac{1}{4}p(x^*, y^*)L$$

Total Vehicle Size Waste is

$$\bar{s}r + \bar{t}r = \frac{1}{2}p(x^*, y^*)L$$

Tax on SUV?

Let,

τ be the *Ad Valorem* tax on vehicle size

Now, in equilibrium: X solves

$$min_s\{C_X + rs = x^* + \frac{t}{s+t}p(x^*, y^*)L + (1+\tau)rs\}$$

Similarly, Y solves

$$min_t\{C_Y + rt = y^* + \frac{s}{s+t}p(x^*, y^*)L + (1+\tau)rt\}$$

In equilibrium, we get we get

$$\bar{s} = \bar{t} = \frac{1}{4(1+\tau)r}p(x^*, y^*)L$$

Total Vehicle Size Waste is

$$\bar{s}r + \bar{t}r = \frac{1}{2(1+\tau)}p(x^*, y^*)L$$

Rule of Strict Liability with Defense

Proposition

Under the rule of strict liability with defense of contributory negligence, in equilibrium X and Y will choose x^* and y^*, respectively.

However, under the Rule of Strict Liability with Defense, at (x^*, y^*)

$$\begin{aligned} C_X &= x^* + (1-\alpha)p(x^*, y^*)L = x^* + \frac{s}{s+t}p(x^*, y^*)L \\ C_Y &= y^* + (1-\beta)p(x^*, y^*)L = y^* + \frac{t}{s+t}p(x^*, y^*)L \end{aligned}$$

So, in equilibrium X and Y will choose $s^* = 0$ and $t^* = 0$, respectively.