

Accident Law and Ambiguity

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- This paper is about accident law or tort.
- Accidents are the cause of many environmental problems, e.g. BP, Bhopal.
- In an accident there is an externality. One party takes actions which risk damaging the property or livelihood of another.
- Tort law aims to ensure that individuals take into account social welfare when taking decisions.
- Risks are ambiguous when it is impossible or difficult to assign subjective probabilities.
- We study how tort law is affected by ambiguity.

Why are Accidents Ambiguous?

- Many accidents are rare events.
- Agents do not have time to make enough observations to get reliable relative frequencies on which to base subjective probabilities.
- Accidents can be very complex e.g. the recent BP oil spill.
- This also makes it hard to assign subjective probabilities.
- Accidents depend on the behaviour of others, which is inherently difficult to predict.
- Almost all the work done in tort considers objective probabilities or known subjective probabilities.
- Potential injurers and victims may be unsure about the probability of accident. May be ambiguity-averse or ambiguity-seeking.

- In the basic model, there are two agents, an injurer and a victim, Shavell, (1987), *Economic Analysis of Accident Law*, Harvard.
- For instance the injurer could be a motorist and the victim a pedestrian.
- We assume that it is clear who is the injurer and who is the victim.
- We confine attention to monetary losses.

- There a chance that there will be an accident, which results in damage to the victim.
- Both the victim and the injurer have two choices;
 - They can choose a level of *care* and a *non-observable action*.
- The chance of an accident can be reduced if the injurer takes care, e.g. drives more slowly.
- In addition the chance of an accident decreases if the non-observable action is reduced, e.g. drives down the road less frequently.

Tort without Ambiguity

- The injurer can take care x at cost $a(x)$, where $a' > 0$, and $a'' > 0$. The victim can also take care y , and incur a cost of $b(y)$, where $b' > 0$, and $b'' > 0$.
- The probability of an accident is p .
- Let $D(x, y)$ be the damage caused by the accident such that $D_x < 0$, $D_y < 0$, $D_{xx} < 0$, $D_{yy} < 0$.
- Social Welfare is measured by total surplus.
- So the social cost from the accident is

$$L(x, y) = pD(x, y) + a(x) + b(y).$$

- The first order conditions for efficient levels of care are

$$a'(x^*) = -pD_x(x^*, y^*) \text{ and } b'(y^*) = -pD_y(x^*, y^*).$$

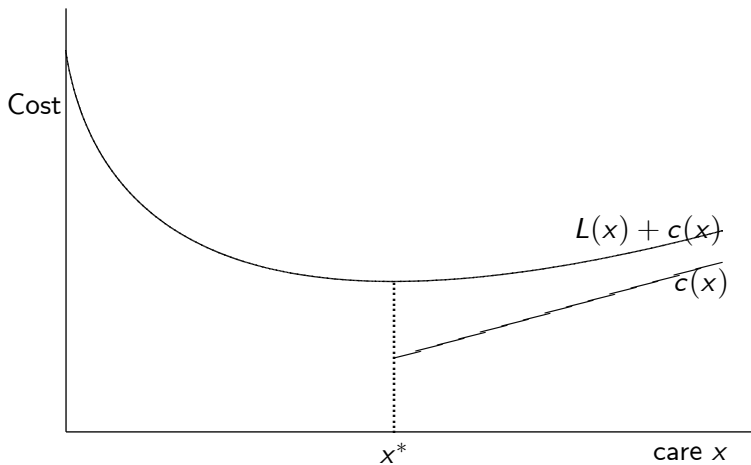
- This defines the efficient levels of care x^* and y^* .

We describe some legal rules which courts apply.

- The injurer pays the full cost of the damages in all circumstances.
- The injurer will supply the optimal level of care and will choose the optimal level of the non-observable action, since the externality has been internalised.
- However since the victim does not bear any cost this may reduce the victim's incentive to take care.
- Similarly the victim is likely to choose an excessive non-observable action.
- If the injurer is a firm, strict liability may cause the firm to shut down even when this is not efficient.

- The injurer pays the full cost of the damages if the level of care is below a specified level x^* . Otherwise the victim bears the full cost.
- If x^* is set correctly the injurer will supply the optimal level of care.
- Given the injurer supplies care at the specified level, the victim bears the full cost of an accident.
- Since the externality is internalised, the victim will supply the efficient levels of care and non-observable actions.
- Assumes the court can determine the correct level of care.
- Provided (s)he chooses care level x^* , the injurer faces no cost of increasing the non-observable action. Thus the injurer is likely to choose a non-observable action which is too high.

Strict Liability



Strict Liability with Contributory negligence

- The injurer pays the full cost of the damages unless the victim provided a level of care less than a critical level y^* , in which case the victim receives nothing.
- If the court chooses y^* correctly the victim will choose the optimal level of care.
- Given the victim chooses y^* the injurer will bear the full marginal cost of his/her action and so will also choose the optimal level of care.
- Problem: By increasing the non-observable action, the victim imposes an externality on the injurer but does not pay a cost for this.
- Thus there is a risk the victim will choose an excessive activity level.

THE ELLSBERG PARADOX

An urn contains 90 balls, 30 of which are red R . The remainder are either blue, B , or yellow, Y . Subjects are not told the proportion of blue and yellow balls.

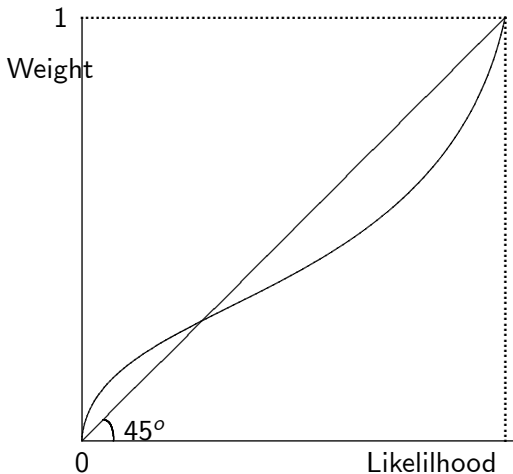
		R	B	Y		Data
Choice 1	a	100	0	0	✓	71%
	b	0	100	0		29%
Choice 2	c	100	0	100		32%
	d	0	100	100	✓	68%

- Most subjects prefer a to b and d to c . This is not compatible with maximising expected utility.
- Some subjects prefer b to a and c to d . Such subjects are said to be ambiguity seeking.

Experimental Evidence on choice under uncertainty shows:

- Behaviour under ambiguity is different from behaviour under risk.
 - e.g. in the Ellsberg Paradox;
- The dominant mode of behaviour is ambiguity-aversion, e.g. avoiding risks with unknown probabilities.
- Ambiguity-seeking is common for highly unlikely events.
- Ambiguity-seeking is common for choices involving losses.

DECISION WEIGHTS



- We use a model of ambiguity axiomatised by Chateauneuf, Eichberger and Grant, where preferences are represented by:

$$\alpha \delta M(a) + \delta(1 - \alpha) m(a) + (1 - \delta) \mathbf{E}_{\pi} u(a), \quad (1)$$

- $M(a)$ denotes the maximum utility of act a ,
- $m(a)$ denotes the minimum utility of act a ,
- $\mathbf{E}_{\pi} u(a)$ denotes the expected utility of act a with respect to probability distribution π .

- δ is a measure of perceived ambiguity;
- α measures ambiguity-attitude, $\alpha = 1$ (resp. $\alpha = 0$) corresponding to pure optimism (resp. pessimism).

- Only 2 additional parameters needed compared to expected utility.
- This model is a special case of CEU Schmeidler (Econometrica 1989).

Tort with Ambiguity

- We assume that both the accident and the behaviour of the other individual are ambiguous.
- Assume first that the court does not perceive ambiguity.
- We assume that agents do not know the true probability, p , of an accident.
- Instead they consider a set of probabilities q to be possible,

$$(1 - \delta) p \leq q \leq \delta + (1 - \delta) p.$$

- The set of probabilities contains the true probability p .
- Under strict liability, the (Choquet) expected utility for the injurer and the victim is respectively:

$$L_{iA}^s(x, y) = \delta_i \alpha_i D(x, 0) + (1 - \delta_i) p D(x, y) + a(x)$$

$$L_{vA}^s(x, y) = b(y).$$

Strict Liability with Ambiguity I

Ambiguity-Aversion

- Ambiguity-aversion increases the marginal benefit of care for the injurer.
- Hence the injurer takes excessive care.
- The victim perceives the injurer's action to be ambiguous and hence unreliable. Thus the victim will also undertake positive care.
- Similar results apply to non-observable actions.
 - Note strict liability does not distinguish between observable variables and non-observable variables.

Strict Liability with Ambiguity II

Ambiguity-Preference

Under strict liability, the (Choquet) expected utility for the injurer and the victim is the respectively:

$$L_{iA}^s(x, y) = \delta_i \alpha_i D(x, 0) + (1 - \delta_i) p D(x, y) + a(x)$$

$$L_{vA}^s(x, y) = b(y).$$

- Ambiguity-seeking is likely as this is in the domain of losses and accidents are unlikely events.
- If the injurer is sufficiently ambiguity-seeking, (s)he will take insufficient care.
- Don't worry she'll be right mate.

Negligence with Ambiguity-Aversion

- Under negligence the (Choquet) expected utility for the injurer is,

$$\begin{aligned}L_{iA}^n(x, y) &= \delta_i \alpha_i D(x, 0) + (1 - \delta_i) p D(x, y) + a(x), \text{ if } x < x^*; \\ &= a(x), \text{ if } x \geq x^*.\end{aligned}$$

- For the victim the (Choquet) expected utility is,

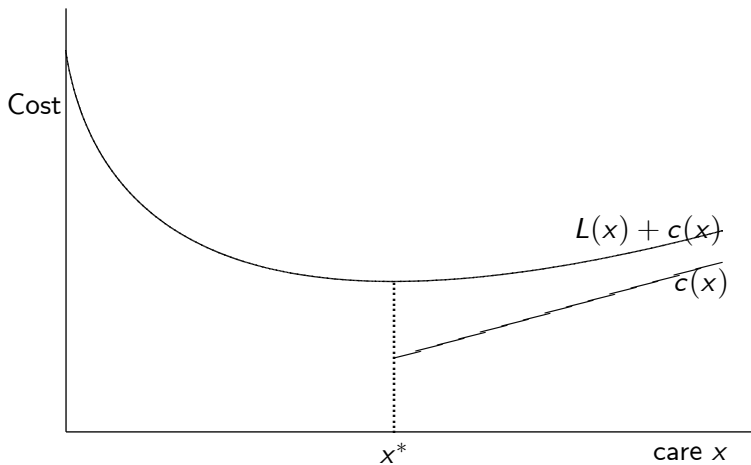
$$\begin{aligned}L_{vA}^n(x, y) &= \delta_v \alpha_v D(0, y) + (1 - \delta_v) p D(x, y) + b(y), \text{ if } x \geq x^*; \\ &= \delta_v \alpha_v D(x^*, y) + b(y), \text{ if } x < x^*.\end{aligned}$$

- Ambiguity-aversion will increase the incentive for the injurer to choose the stipulated care level, x^* .
- Ambiguity-aversion may also increase the victim's care level.

Negligence with Ambiguity-Preference

- The negligence rule creates a non-convexity of the injurer. There are thus two types of equilibria.
- For low ambiguity preference the injurer takes stipulated care.
 - The victim supplies no care.
 - Non-observable actions of both parties will be too high.
- For high ambiguity preference, the injurer takes a low level of care.
 - The victim will make a positive investment in care but due to ambiguity-preference will under-invest.
 - The non-observable action of the victim will be too high
 - The effect on the injurer's choice of non-observable action is ambiguous.
- Negligence is more robust to ambiguity preference.

Strict Liability



Strict Liability with Contributory negligence Ambiguity-Aversion

- The victim chooses stipulated care.
- The injurer chooses excessive care.

Ambiguity-Preference

- The victim either chooses stipulated care or very low care.
- The injurer under-invests in care.

Non-Observable Actions

- Assume, for simplicity, that the care level is fixed.
- Shavell argues that no rule will give both agents an incentive to choose the correct non-observable action.
- If the injurer pays the damage, then (s)he will choose the optimal non-observable action but the victim will choose an action which is too high.
- If the injurer pays fraction α of the damage and the victim pays fraction $1 - \alpha$ then both have an incentive to choose excessive actions.
- Non-linear divisions of the loss do not help.
- Without ambiguity, there is no rule which implements the optimal actions and satisfies budget balance.

Ambiguity and Non-Observable Actions

- With ambiguity-aversion it is possible to implement the optimal non-observable actions.
- The following rule will implement the optimal non-observable actions.
 - The victim pays the full cost of the damage.
 - Unless the damage is very high in which case the injurer pays a large fine (punitive damages) to the victim.
 - The fine is only levied when the damage is so high that it is clear that **both** parties have used excessive actions.
- If the fine is sufficiently high, ambiguity-aversion will cause the injurer to adopt the optimal action.
- This removes the risk of being fined.
- The victim will choose the optimal activity level since, in equilibrium, (s)he bears the full marginal cost of accidents.

- Negligence is more robust to ambiguity than strict liability.
- Should the concept of efficiency be modified to take account of ambiguity?
- E.g. with ambiguity-aversion negligence is ex-post Pareto optimal.
- However this neglects the ex-ante loss in utility which individuals suffer due to ambiguity.

CONCLUSION II

The Court Perceives Ambiguity

- We have assumed that the injurer and victim perceive ambiguity but the court does not.
- The analysis of strict liability would not be affected.
- Most results will still apply for any level of stipulated care the court enforces.
- If the court does not know p then it is likely that x^* and y^* will be ambiguous.
- This acts to reinforce other effects.
- An ambiguity preferring decision-maker will provide too little care, since (s)he over-weights the possibility that the court sets stipulated care too low.
- Similarly an ambiguity-averse individual will choose a level of care which is too high.

CONCLUSION III

Acts of God

- Tort Law says that the injurer is not liable if the damage was due to an unanticipated event.
- There are similar 'Act of God' clauses in building and insurance contracts.
- This may also be explained by ambiguity.

Related Literature

- Teitelbaum, *Journal of Legal Studies*, 2007, studies ambiguity and accident law.
 - Only the injurer is affected by ambiguity.
 - The present paper combines Teitelbaum with models of ambiguity in games, such as Eichberger and Kelsey, *GEB* 2000, Kelsey and Spanjers, *EJ* 2004.