Erasmus Programme in Law and Economics

Economic Analysis of Tort Law and Insurance II

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Compensation for pain and suffering

I. Why we have no insurance against pain

This is a simplified version of a concept by David Friedman „What is fair compensation for Death or Injury?", International Review of Law and Economics, Vol. 2 1982. It is based on some simple calculations with real numbers. But the result, that an individual cannot increase his utility by insuring himself against pain, is more general.

1. Assume that a person who might loose her leg by an accident and consequently suffers physical as well as psychic pain is asked to attach a number between 0 and 10 to the degree of pain she is expected to suffer. 0 means no pain, 10 is the number fixed for an individual, who is completely disabled and suffers heavy physical pain. Assume further that the individual answers this question to the best of his ability (without moral hazard).

2. Assume further that the individual derives utility (u) from his income (y) and loses utility from pain (p) and that the relationship between utility, income and pain can be described by the following equation:

$u = \sqrt{y} - p^2$. This expresses that utility (u) increases with income (y) but less than proportionately and that utility (u) decreases with pain (p) but more than proportionately. This is the crucial assumption behind the proposition in this text, not the particular type of the equation.

If this individual is certain not to suffer any pain and receives an income of 400, her utility will be 20 units (utils).

$$u = \sqrt{400} = 20$$

Assume that an individual has valued her pain in case of losing a leg on the scale between 0 and 10 with 4 and assume further that the same individual faces a risk of 10 percent of actually losing her leg. Assume also that if the individual suffers this accident her income will not be affected and remains the same as without the accident. Also the costs of medical treatment are paid by a third party and are therefore excluded from further consideration. The expected utility (eu) of the individual is then

$$eu = 0.9 * \sqrt{400} + 0.1 * (\sqrt{400} - 4^2) = 0.9 * 20 + 0.1 * (20 - 16) = 18.4$$

Thus the utility level is lower than without the possibility of this accident.

We now ask for the additional income (Δy) which would compensate the individual fully for a pain of 4 on the ratio scale. Full compensation must lift the individual to the utility level he would have without the pain, which is u=20. Therefore we get the following equation:

$20 = \sqrt{400 + \Delta y} - 4^2;$

$\Delta y = 896$

In the square root expression Δy symbolises the additional income necessary to compensate the individual fully for the pain. Full compensation for the pain is 896, you can easily check this by solving the square root expression and replacing Δy by 896.

Now assume that this individual is offered a „paininsurance“ . He gets 896 extra income if he loses a leg to compensate him for his pain. The insurance premium for the individual is (disregarding handling costs of the insurance company)
0.1*896=89.6. This premium is due no matter whether the individual suffers an accident or not. If he buys this insurance his expected utility (eu) will be

$$eu = 0.9 * \sqrt{400 - 0.1 * 896} + 0.1 * (\sqrt{400 - 0.1 * 896 + 896} - 4^2) = 17.73$$

The expected utility without a paininsurance is higher than with such an insurance as you can see from comparing the level of utility with and without a pain insurance. Unlike an insurance against loss of income an insurance against pain does not increase but decrease expected utility. This has consequences for the assessment of damage compensation for pain and suffering.The proper valuation of compensation for pain and suffering is not full compensation but compensation for reasons of optimal deterrence.

Compensation should be based on the amount of money the individual would be willing to invest into safety to reduce marginally the risk of suffering this accident. This is however an altogether different calculation and in practice leads to much lower values. The actual compensation paid for pain and suffering is (in many European countries) however even much below this relatively low level of a compensation of pain and suffering leading to optimal deterrence.

Optimal deterrence against pain and suffering

The methodologically crucial question to define conceptually the optimal amount of investment to reduce accidents with bodily harm is: How much would an individual be prepared to invest into safety and thus reduce her disposable income? For further analysis assume that the only risk in question is again to lose an arm or leg or eye and that the individual values the pain (physical as well as psychic) resulting from such an accident with 4 on the ratio scale. Contrary to the above analysis it is now assumed that the risk of suffering pain (due to an accident) is now dependent on the investment of this individual into safety (x)

The probability of suffering an accident which leads to a pain of 4 on the ratio scale is w with $1 \geq w \geq 0$. This w is dependent on the level of safety investment. We thus get a function between the level of safety investment and the probability of an accident. It is now assumed that this function is

w=0.2/(1+x).

With an increasing safety investment the accident probability is reduced, albeit with an ever increasing effect. With x approaching infinity it becomes 0. The probability of not suffering an accident is then 1-w.

On the one hand the investment into safety reduces the probability of an accident and of pain and therefore increases utility, on the other hand the investment reduces the disposable income and thus reduces utility level. What is the optimal investment level? If we take the same functions as above and the same income level (25) we get.

$$\textit{Maximise } \text{eu} = (1 - w(x)) * \sqrt{400 - x} + w(x) * (\sqrt{400 - x} - 4^2)$$

or -making use of the relationship between the probability of an accident and the safety investment (x).

$$\textit{Maximise } \text{eu} = (1 - 0.2 / (1 + x)) * \sqrt{400 - x} + 0.2 / (1 + x) * (\sqrt{400 - x} - 4^2)$$

The maximization (form 1. derivative and equate it with 0) yields the optimal value for x. (This was calculated with a computer programme.)

x*=10.24.

Each safety investment (x) which is higher or lower than 10.24 leads to a lower expected utility.This means that given the income, safety technology and the utility function, the individual would not be willing to invest more than 10.24 to reduce the probability of an accident with the described pain (p=4). This leads to an (optimal) accident probability of 1.8%.

w*=0.2/(1+10.24)=0.018

From this it is now possible to calculate how the individual values the avoidance of 1 of the described accidents. We ask, how much a very small reduction of the accident probability would cost at the optimal point (x*,w*).

as w*=0.2/(1+x*) we get for x
x*=(0.2/w*)-1 and for
dx*/dw*=0.2/w^2 if we put the optimal value of w*=0.018 into this equation we get
dx*/dw*=617

This is the optimal amount to avoid -statistically- 1 accident with the described consequences of pain. If one includes losses of future earning, medical costs etc this value is equivalently higher. The amount of 617 describes only the individual´s willingness to invest into safety to avoid the pain. A tort system aiming at setting and enforcing safety standards in line with individual preferences should therefore -for reasons of deterrence- attribute this amount of compensation for pain and suffering to the tortfeasor (not the higher value which fully compensates the victim).

In the case of Germany it seems, that the compensation paid for pain and suffering is however too low by a factor 3 if one uses this yardstick to evaluate the optimal compensation for pain and suffering.