Moral Hazard in Insurance Markets

Moral hazard arises when the individual, by exerting some effort or incurring some expenses, has some control over either the probability or magnitude of the loss, but neither the effort nor the expenses are observed by the insurer and hence the insurance policy cannot be made a function of such effort or expenses. We will see that in such situations insurance companies do not want to offer full insurance.

TWO LEVELS OF EFFORT and MONOPOLY

What is the profit-maximizing insurance policy for a monopoly when there is moral hazard? Let $W$ be the initial wealth and $x$ the potential loss. The probability of loss depends on some unobservable effort of the individual, which can take on two values: $n$ (no effort) and $e$ (effort). If the individual chooses $n$ then the probability of loss is $p_n$ and if she chooses $e$ then the probability of loss is $p_e$ with $0 < p_e < p_n < 1$. The individual’s utility depends on wealth (denoted by $m$) and effort and is given by

$$U(m,e) = \begin{cases} \sqrt{m} & \text{if no effort} \\ \sqrt{m-c} & \text{if effort} \end{cases}$$

with $c > 0$.

Given an insurance contract $(h,d)$, the individual will compute

1. her expected utility if she does not buy insurance and chooses no effort; denote this by $EU_n(NI)$
2. her expected utility if she does not buy insurance and chooses effort; denote this by $EU_e(NI)$
3. her expected utility if she buys insurance and chooses no effort; denote this by $EU_n(h,d)$
4. her expected utility if she buys insurance and chooses effort; denote this by $EU_e(h,d)$

and will choose the option that gives her the highest expected utility.

EXAMPLE. Suppose that $W = 10,000$, $x = 1,900$, $p_e = \frac{1}{10}$, $p_n = \frac{4}{10}$, $c = 2$. Then

$$EU_e(NI) = \frac{6}{10} \sqrt{10,000} + \frac{4}{10} \sqrt{10,000 - 1,900} = 96$$

$$EU_n(NI) = \frac{9}{10} \sqrt{10,000} + \frac{1}{10} \sqrt{10,000 - 2} = 97.$$ 

Thus if she decides not to insure then she will exert effort. Consider the partial insurance contract $(h = 800, d = 200)$. Then

$$EU_n(800,200) = \frac{6}{10} \sqrt{10,000 - 800} + \frac{4}{10} \sqrt{10,000 - 800 - 200} = 95.497.$$
\[ EU_e(800,200) = \frac{9}{10}\sqrt{10,000-800} + \frac{1}{10}\sqrt{10,000-800-200} - 2 = 93.812 \]

Hence if she decided to purchase the contract then she would choose no effort, but she is better off not insuring. Hence the individual will **choose not to insure and will exert effort**.

**From now on we will assume that** \( EU_e(NI) > EU_n(NI) \), **that is, if not insured the individual will choose to exert effort.** This will be true if \( c \) is sufficiently small.

Now, it is clear that for any full insurance contract \((h,0)\), \( EU_n(h,0) > EU_e(h,0) \); that is, once fully insured the individual has no incentive to exert effort (if the loss occurs then she gets fully reimbursed by the insurance company and exerting effort only reduces utility from \( \sqrt{W - h} \) to \( \sqrt{W - h - c} \)). On the other hand, we assumed that \( c \) was sufficiently low for the individual to choose effort when not insured (that is, at \( NI = (0,x) \): \( NI \) can be thought of as the contract \((h = 0,d = x)\)). Thus \( EU_e(0,x) > EU_n(0,x) \) but \( EU_e(h,0) < EU_n(h,0) \). Consider the indifference curve that goes through \( NI \) when the individual exerts effort. At \( NI \) we have that \( EU_e > EU_n \) but at the point of intersection between the indifference curve and the 45° line we have that \( EU_e < EU_n \). Hence there must be a point \( A \) on that curve where \( EU_e(A) = EU_n(A) \).

Since we are traveling along the \( NI \)-indifference curve for level \( EU_e(NI) \), the value of \( EU_e(h,d) \) remains constant at \( EU_e(NI) = EU_e(0,x) \). The function \( EU_n(h,d) \) increases, since we are moving to higher and higher indifference curves corresponding to no effort, as shown in the following figure.

![Diagram](image_url)

Contract \( A = (h_A,d_A) \) is found by solving the following pair of equations:

\[
EU_e(h,d) = EU_e(NI) \quad \text{(we are on the } e\text{-indifference curve through } NI) \\
EU_n(h,d) = EU_e(h,d) \quad \text{(at } (h,d) \text{ the } n\text{-indifference curve and the } e\text{-ind. curve cross)}
\]
In the above numerical example, \( A = (h_A = 66.56, d_A = 1,284.44) \).

The monopolist will want to keep the individual on “the indifference curve through the \( NI \) point”. But which indifference curve? The individual’s reservation indifference curve is the union of two different pieces: the first piece is the portion – up to point \( A \) – of the indifference curve corresponding to effort that goes through \( NI \); the second piece is the portion of the indifference curve corresponding to no effort and to utility level \( EU_e(NI) \), as shown in the following picture.

Since profits increase as we move along the indifference curve towards the 45° line the profit maximizing contract subject to the constraint that the individual chooses effort is \( A \). An increase in either the premium or the deductible (or both) will induce the individual to switch to no effort and thus the relevant indifference curve from there on is the portion of the indifference curve through \( NI \) corresponding to the case of no effort and a utility level equal to \( EU_e(NI) \) (the agent’s reservation utility if he does not insure and thus chooses effort). Of the points on that portion of the indifference curve, the monopolist would choose point \( F \) corresponding to full insurance (the monopolist’s profits increase along the indifference curve moving towards the 45° line). Thus the monopolist will choose between contracts \( A \) and \( F \): it will pick the one that maximizes profits.

Contract \( F \) is given by the solution to \( \sqrt{W - h} = EU_e(NI) \), that is,

\[
\sqrt{W - h} = p_e \left( \sqrt{W - x} \right) + (1 - p_e) \left( \frac{\sqrt{W}}{d_e(NI)} \right) - 2
\]

In the above numerical example, Contract \( F \) is given by the solution to

\[
\sqrt{10,000 - h} = \frac{1}{10} \sqrt{8,100} + \frac{9}{10} \sqrt{10,000} - 2
\]

which is \( F = (h = 591, d = 0) \).