ECONOMICS I.

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ECONOMICS I.

week 10

The economics of risk and information

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Information and risk

- So far we have assumed that the consumers have perfect information about their income and personal preferences, and that producers also have perfect information about their technology and costs.
- The assumption of perfect information is easy to use and most of our conclusions are valid even if we relax this assumption.
- Some phenomena or the existence of some institution, however, cannot be understood without uncertainty.
- Without uncertainty there would be no insurance companies, no need to employ advisors, court suits, marketing, not even mentioning scientific research.
- One of the important result of uncertainty is that some actors have more information than others (e.g. a jeweler can better estimate the value of a diamond than the customer).
- If all actors are similarly uncertain about some important factor, then we talk about *symmetric* information or information structure, but if some are more uncertain than others, then we have *asymmetric information structure.*

1 Decision under uncertainty

Expected gain

Suppose an airline must decide whether to send off a flight from Los Angeles to Chicago, despite being unsure about the weather at O'Hare airport in Chicago by the time the flight arrives. The plane has already 100 people aboard. If the flight is dispatched and O'Hare is open, suppose the airline will gain $40.000. If the airline hold the flight until the weather clears, the disruption in the schedule will make its gain smaller, say only $20.000. But if the flight departs and finds Chicago snowed under, returning the plane to Los Angeles and reboarding the passengers later will cause a loss of $30.000. Suppose also that the airline estimates that the chance of O'Hare airport being closed is 25%. What should the airline do?

Let us estimate the expected value of the possible gains!

- Expected gain if dispatch: $= [0,75 \times 40000] + [0,25 \times (-30000)] = \$22500$.
- Expected gain if delay $= \$20000$.

Definition 1 *For all possible a_1 actions, let us estimate the value of all possible outcomes $V_{i1}, V_{i2}, V_{i3}, \ldots, V_{ij}, \ldots, V_{iS}$! Multiply these values with the probability of them being true $\pi_1, \pi_2, \pi_3, \ldots, \pi_j, \ldots, \pi_S$, and add them up. Now we get the expected value of the given action:*

$$E\left[V(a_i)\right] = \pi_1 V_{i1} + \pi_2 V_{i2} + \pi_3 V_{i3} + \ldots + \pi_j V_{ij} + \ldots + \pi_S V_{iS} =$$

$$= \sum_{j=1}^{S} \pi_j V_{ij}$$

Definition 2 *Let us do these calculations for all possible actions, and choose the one with the highest expected value. That is, from all possible $a_1, a_2, a_3, \ldots, a_i, \ldots, a_n$ actions, choose the one with the highest $E\left[V(a_i)\right]$ expected value!*

Example: If I toss a coin and it's head, then we get the amount in the left column, if tail then the right. (note: $\pi_{head} = \pi_{tail} = 0,5$). Which action would you choose?

a_i	*head*	*tail*
a_1	2000	2000
a_2	1000	3000
a_3	0	4000
a_4	-2000	6000

Note, however, that the expected value is the same in all of these actions! ($E\left[V(a_1)\right] = E\left[V(a_2)\right] = E\left[V(a_3)\right] = E\left[V(a_4)\right] = 2000$) But the variance is not the same!

$$Var\left[V(a_1)\right] = 0$$

$$Var\left[V(a_2)\right] = 0,5(1000 - 2000)^2 + 0,5(3000 - 2000)^2 =$$

$$Var\left[V(a_2)\right] = 0,5(0 - 2000)^2 + 0,5(4000 - 2000)^2 =$$

$$Var\left[V(a_2)\right] = 0,5(-2000 - 2000)^2 + 0,5(6000 - 2000)^2 =$$

So they are differently *risk*y!

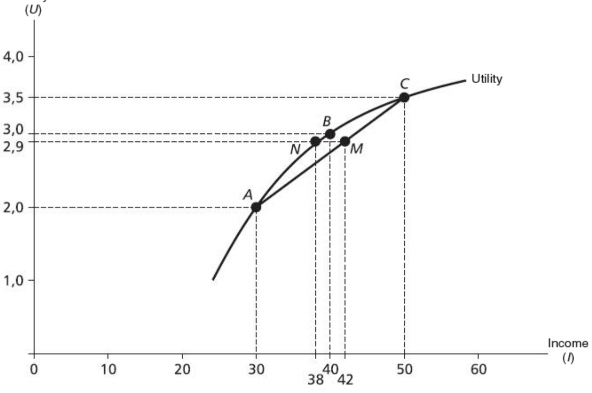
Expected utility

Definition 3 Expected utility *is the probability-weighted average of the utilities attached to all the possible outcomes:*

$$E\left[U(a_i)\right] \equiv \pi_1 U\left[V_{i1}\right] + \pi_2 U\left[V_{i2}\right] + \pi_3 U\left[V_{i3}\right] + \ldots +$$

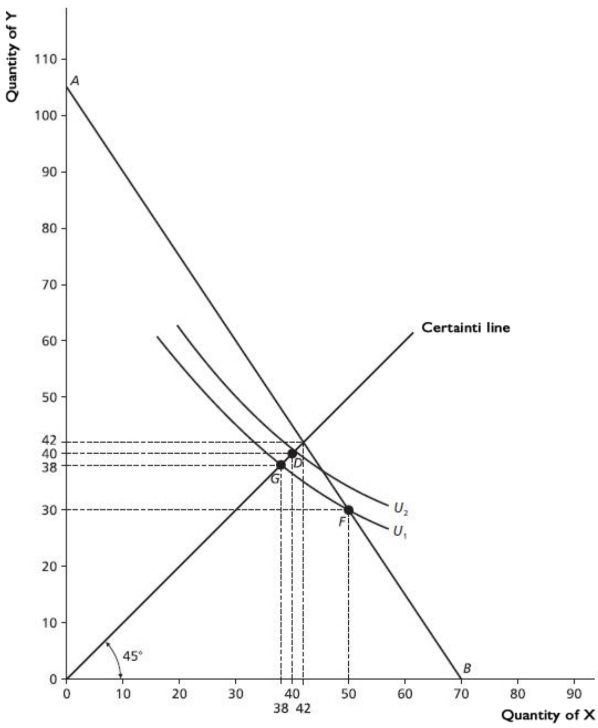
$$\pi_j U\left[V_{ij}\right] + \ldots + \pi_S U\left[V_{iS}\right] = \sum_{j=1}^{S} \pi_j U\left[V_{ij}\right]$$

Definition 4 *If the marginal utility of income is diminishing for someone, s/he is* risk averse.



Points A and C are the possible outcomes of Helen's risky job; point B represents the safe job. Since the probability of good outcome C is 0.6, the expected utility of the risky job is shown by point M, 6/10 of the distance from A towards C. Since M is lower on the utility scale then point B, Helen should prefer the safe job. The sure salary that would give Helen the same utility as the risky job is shown by point N, whose vertical coordinate is the same as point M.

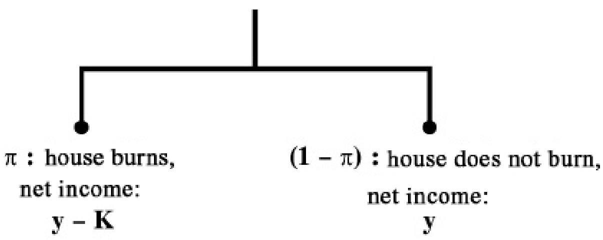
Risk premium
Line AB shows all the possible combinations of stage-continent incomes in Prosperity and Recession whose expected value is the same as the sure income represented by point D along the certainty line. The risky job offer is represented by point F along AB. Point F lies on the same indifference curve as point G, lower down on the certainty line. The monetary difference between point F and point G is the risk premium.



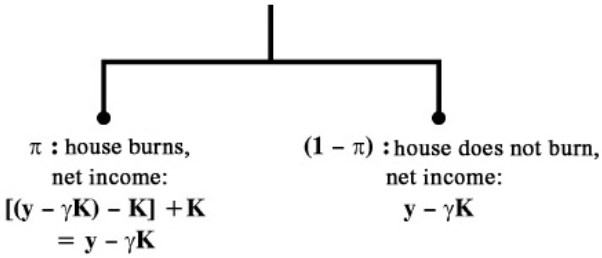
Risk bearing and insurance

- y: value of the house
- π: probability of the damage
- K: size of the damage
- Two possible outcomes: house burns down (1), does not burn down (2)
- γK: insurance fee (γ: insurance quota)

Consumption without insurance:



Consumption with insurance:



	Outcome	
Consumption plan	house burns (T)	house not burn (N)
No insurance (A)	$c_T^A = y - K$	$c_N^A = y$
Insurance (B)	$c_T^B = y - \gamma K$	$c_N^B = y - \gamma K$

E.g. John has \$300.000. He invested one-third of that into a valuable painting, worth of \$100.000. The chance of the painting being stolen is 40%. Let's assume that he can buy an insurance for \$40.000 which pays \$100.000 in case of theft.

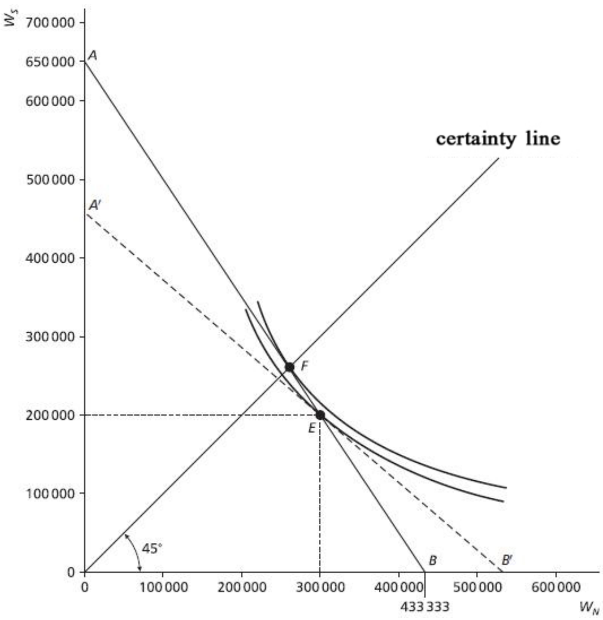
Definition 5 *A bet (or insurance) is* equitable *if the expected gain ($E[G]$) from that is zero:*

$$E[G] = \pi H + (1 - \pi)(-F) = 0$$

If an insurance is equitable, then

$$\frac{H}{F} = \frac{1-\pi}{\pi}$$

$$\frac{60000}{40000} = \frac{0,6}{0,4}$$



Definition 6 *A person is risk averse if prefers to move towards the 45° certainty line, when offered an equitable bet (or insurance).*

Certainty-equivalent of an option to buy a share at $30

		Current stock price			
Risk averse	exposure	15$	30$	45$	60$
r=2	50%	2,5	12	22	32
r=2	67%	2,0	8	17	25
r=3	50%	1,8	7	13	22
r=3	67%	0,6	3	9	15

source: Hirshleifer et al., 2009, 412.