Health Economics
Demand and supply of health insurance

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Insurance plays a major role in the health economy

Health care expenses are uncertain - they can be ruinous to households

Most people do not pay directly for health care

Coinsurance - the portion that patients pay directly

Coverage provided by premiums or taxes

Premiums are usually purchased through labor market participation
Desirable characteristics of insurance arrangements

1. The number of insured should be large, and they should be independently exposed to potential loss.
2. The losses covered should be definite in time, place, and amount.
3. The chance of loss should be measurable.
4. The loss should be accidental from the viewpoint of the person who is insured.

The law of large numbers

Outlays for a health event may be highly variable for any person, however, the average outlays for the whole group can be predicted fairly well.
Insurance terminology

- **Premium, coverage**: people pay a given premium for a given coverage.
- **Coinsurance, copayment**: percentage of copayments by the insured person is the coinsurance rate.
- **Deductible**: the insurance does not apply until the consumer pays the deductible.
- **Exclusions, limitations, pre-existing conditions, loading fees**

Economist’s view

- Copayments make consumers more alert of true treatment cost.
- Deductibles may discourage frivolous claims and visits.
- Side effects of deductibles?
People’s choices under uncertainty with known probabilities

Expected value

\[ E = p_1 R_1 + p_2 R_2 + \ldots + p_n R_n \]

\( p_i \ldots \) probability of outcome \( i \)

\( R_i \ldots \) return if outcome \( i \) occurs

\[ \sum_{i=1}^{n} p_i = 1 \]

Actuarially fair insurance policy: the expected benefits paid out by the insurance company are equal to the premiums taken in by the company.

In reality, however, companies must also cover administration and transaction cost.
People may reject an actuarially fair bet – probably on the grounds that a person cannot afford the risk of a loss →

Disutility of losing money is larger than the utility of winning a similar amount: RISK AVERSION

This is true, for example, if a person feels that the utility of an extra dollar of wealth is worth more when she is relatively poorer than the utility of an extra dollar of wealth is worth when she is relatively richer.

Diminishing marginal utility of wealth - a concave utility function
Insurance and utility of wealth

The graph illustrates the relationship between total utility of wealth and wealth. Points A, B, C, D, and E are marked on the graph, with various utility values and wealth levels indicated. The graph shows how total utility changes as wealth increases.
Expected wealth and purchasing insurance

Suppose: Wealth if well \( W^W = $20,000 \)
Wealth if ill \( W^I = $10,000 \)
Probability of becoming ill \( Pr(I) = 0.05 \)

Exp. Wealth: \( E(W) = (1 - Pr(I))W^W + Pr(I)W^I \)
\[ 0.95 \times 20,000 + 0.05 \times 10,000 = $19,500 \]

Exp. Utility: \( E(U) = (1 - Pr(I))U^W + Pr(I)U^I \)
\[ 0.95 \times 200 + 0.05 \times 140 = 197 \]

This expected utility due to risk (197) must be compared to the utility of point D (199): the utility a person would receive if she could purchase an actuarially fair insurance.
Purchasing insurance

- Suppose a person can buy an insurance costing $500 per year that will maintain wealth irrespective of health → net wealth $19,500 → certainty utility 199.
- The person is better off at D than at C. The insurance makes the person better off → she will insure.
- The maximum amount that a person would be willing to pay: $3,000 → point F.

Facts

- Insurance can only be sold when the consumers are risk averse.
- Insurance guarantees fixed wealth.
- Insurance companies may charge more than the actuarially fair premium. Even if people will then have less expected wealth from insuring than from not insuring. The increased well-being comes from the elimination of risk.
Insurance demand

- A person maximizes total net benefits of insurance.
  - a person benefits from insurance if she is ill
  - premium cost occur if the person is well
- The above mentioned example continued:
  - insurance covers losses up to $500
  - a 10 percent premium: $50

### Insurance Worksheet - $500 coverage - Wealth if ill

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>wealth</td>
<td>$20,000</td>
<td>less</td>
<td>Loss</td>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remainder</td>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td>plus</td>
<td>Insurance</td>
<td>$500</td>
<td>Sum</td>
<td>$10,500</td>
<td></td>
</tr>
<tr>
<td>less</td>
<td>Premium</td>
<td>$50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>or</td>
<td>New</td>
<td>wealth</td>
<td>$10,450</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Marginal benefit and cost of health insurance
Optimal coverage

- Marginal benefit from the $500 insurance (MB): the expected marginal utility that the additional $450 brings.
- Marginal cost (MC): expected marginal utility that the $50 premium costs
- MB > MC (points A and A’)
- Should a person increase coverage from $500 to $1,000?
- Compare the marginal benefit of this next $500 increase to its marginal cost.
  - if ill, a person is slightly wealthier than before ($10,450 > $10,000) ⇒ the marginal utility from an additional $450 of wealth will be slightly smaller than before. The MB curve is downward sloping.
  - if well, the person is slightly less wealthy than before ⇔ the additional $50 in premiums cost more in coverage (marginal) utility of wealth. The MC curve is upward sloping.
- optimal coverage: $q^*$
## Changes in premiums

### Insurance Worksheet - Higher premium - Wealth if ill

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Original</strong> wealth</td>
<td>$20,000</td>
</tr>
<tr>
<td>less Loss</td>
<td>$10,000</td>
</tr>
<tr>
<td>Remainder</td>
<td>$10,000</td>
</tr>
<tr>
<td>plus Insurance</td>
<td>$500</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>$10,500</td>
</tr>
<tr>
<td>less Premium</td>
<td>$75</td>
</tr>
<tr>
<td>or <strong>New</strong> wealth</td>
<td>$10,425</td>
</tr>
</tbody>
</table>

- A downward shift of the MB curve
- An upward shift of the MC curve
- Optimal coverage: $q^{**} < q^*$
## Changes in expected loss

### Insurance Worksheet - Higher Expected Loss - Wealth if ill

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Original wealth</strong></td>
<td>$20,000</td>
</tr>
<tr>
<td>less <strong>New loss</strong></td>
<td>$15,000</td>
</tr>
<tr>
<td>Remainder</td>
<td>$5,000</td>
</tr>
<tr>
<td>plus <strong>Insurance</strong></td>
<td>$500</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>$5,500</td>
</tr>
<tr>
<td>less <strong>Premium</strong></td>
<td>$50</td>
</tr>
<tr>
<td><strong>New wealth</strong></td>
<td>$5,450</td>
</tr>
</tbody>
</table>

- An upward shift of the MB curve
- The MC curve remains unchanged
- Optimal coverage: $q^{***} > q^*$
Changes in wealth

<table>
<thead>
<tr>
<th>Insurance Worksheet - Increased Wealth - Wealth if Ill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased wealth $25,000</td>
</tr>
<tr>
<td>less New loss $10,000</td>
</tr>
<tr>
<td>Remainder $15,000</td>
</tr>
<tr>
<td>plus Insurance $500</td>
</tr>
<tr>
<td>Sum $15,500</td>
</tr>
<tr>
<td>less Premium $50</td>
</tr>
<tr>
<td>or New wealth $15,450</td>
</tr>
</tbody>
</table>

- A downward shift of the MB curve
- A downward shift of the MC curve
- Optimal coverage: $q \geq q^*$
How do insurances determine the premiums?
Revenues must cover costs.

**Competition and zero profits**

Our example: a competitive insurance market (zero profits)
probability of illness: 0.05
insurance blocks of $500 are bought
premium: $50 per block (10 percent)
processing cost for each insurance application: $5

Profits = Total revenue − Total costs

Profits per policy =

\[ 50 - Pr(I) \times C^I - (1 - Pr(I)) \times C^W = 
50 - 0.05 \times 505 - 0.95 \times 5 = $20 \]
positive profits attract other firms to enter the market until the premium has fallen to 6 percent
Profits per policy = \(30 - 0.05 \times 505 - 0.95 \times 5 = 0\)

\(a\ldots\text{premium in fractional terms}\)
\(q\ldots\text{pay out}\)
\(p\ldots\text{probability of payout}\)
\(aq\ldots\text{revenue per policy}\)
\(t\ldots\text{processing cost (unrelated to the size of the policy)}\)

\[
Profit = aq - (pq + t) = aq - pg - t
\]
\[
0 = aq - pq - t
\]
\[
a = p + \frac{t}{q} \ldots \text{the competitive premium}\]
The competitive insurance premium

equals the probability of illness $p$, plus the processing (loading) costs as a percentage of policy value $q$.

The actuarially fair insurance rates

correspond to rates with loading costs (as a percentage of coverage) $\frac{t}{q}$ approach zero: $a = p + \frac{t}{q} = p$
The optimal insurance coverage if $a = p$

Initial wealth: $w_0$
Wealth if well: $w_0 - aq$
Wealth if ill: $w_0 - D - aq + q$

$$\max_{a_i} (1 - p) u(w_0 - aq) + p u(w_0 - D - aq + q)$$

f.o.c.: $-a(1 - p) u'(w_0 - aq) + p(1 - a) u'(w_0 - D - aq + q) = 0$

$p = a$: $- p(1 - p)[u'(w_0 - aq) - u'(w_0 - D - aq + q)] = 0$

$u'(w_0 - aq) = u'(w_0 - D - aq + q)$

$u...strictly$ $decreasing \rightarrow$

$$w_0 - aq = w_0 - D - aq + q$$

$D = q$
If the insurance is actuarially fair, the decision maker insures completely.

The individual’s expected final wealth is

$$w_0 - pD$$

for any $q$. If, however, $q = D$ the decision maker reaches $w_0 - pD$ with certainty. Given the individual is risk-avers $q = D$ is the optimal insurance.

For $p < a$: insurance for less than full health expenditure. E.g. substantial loading charges (see also lecture notes, Johann K. Brunner, Notes on welfare economics, p. 38ff.)
Buying insurance may lower the price per unit of service at the time that the services are purchased. Do people buy more service due to insurance?
Moral hazard II

- Suppose $p = 0.5$ for an individual to contract diabetes that requires medical care.
- An actuarially fair insurance policy would charge the individual $0.5P_1 Q_1$.
- Inelastic demand $\rightarrow$ insurance has no impact on quantity demanded.
- If the demand curve is, however, elastic and insurance pays the entire loss $\rightarrow$ the marginal price is zero, $Q_2$ is demanded at $P_1 Q_2$ total cost of care.
- Two possibilities
  - A The company loses money if it charges $0.5P_1 Q_1$ (expected payments $0.5P_1 Q_2$).
  - B The individual may not buy insurance if company charges very high premiums.
- Moral hazard relates to any change in behavior that occurs in response to a contractual arrangement.
The insurance company charges a high premium.

Consumer surplus:

\[ E(CS) = 0.5CS^w + 0.5CS^i \]
\[ a = \frac{P_1Q_2}{2} \]
\[ E(CS) = -0.5 \times \frac{P_1Q_2}{2} \]
\[ + 0.5[\frac{P_PQ_2}{2} - \frac{P_1Q_2}{2}] \]
\[ = -\frac{P_1Q_2}{2} + \frac{P_PQ_2}{4} \]
\[ < 0 \Rightarrow \text{self insurance} \]
Deductibles

Premium: \( a = \frac{P_1 Q_1}{2} \)

Deductible: \( 0P_1 BQ_1 \)

\[ E(CS) = 0.5CS^W + 0.5CS^I \]

\[ -0.5 \times \frac{P_1 Q_1}{2} + 0.5\left[ \frac{P_P Q_2}{2} - \frac{P_1 Q_1}{2} - P_1 Q_1 \right] = \]

\[ -\frac{P_1 Q_1}{2} - \frac{P_1 Q_1}{2} + \frac{P_P Q_2}{4} = \]

\[ -P_1 Q_1 + \frac{P_P Q_2}{4} \geq 0 \]

\[ \geq E(CS) \text{ with self insurance} \]

- A relatively small deductible will have no effect on individual usage, here \( Q_2 \)
- A large deductible makes it more likely that individuals will self-insure and consume \( Q_1 \)
Coinsurance

- A new demand curve is generated
- Incremental cost: $P_0(Q_1 - Q_0)$
- Incremental benefit: $ACQ_1Q_0$
- Welfare loss: ABC
- Implicit subsidization of insured types of care relative to non-health goods.

Insurance

can distort the allocation of resources among health care and other goods.