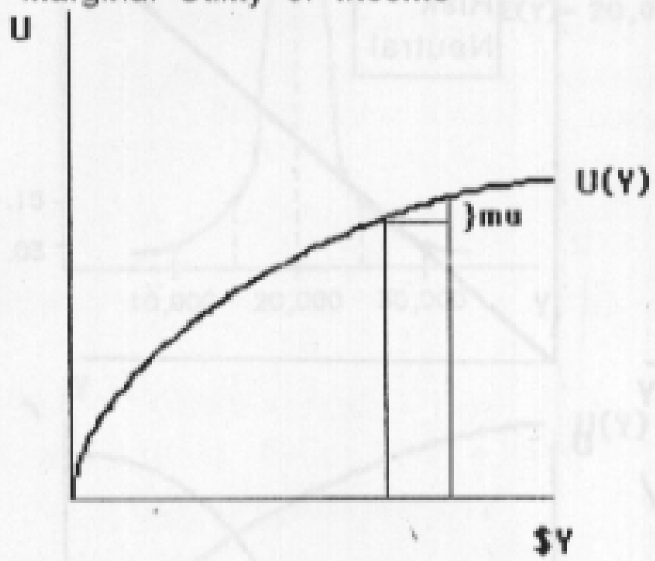
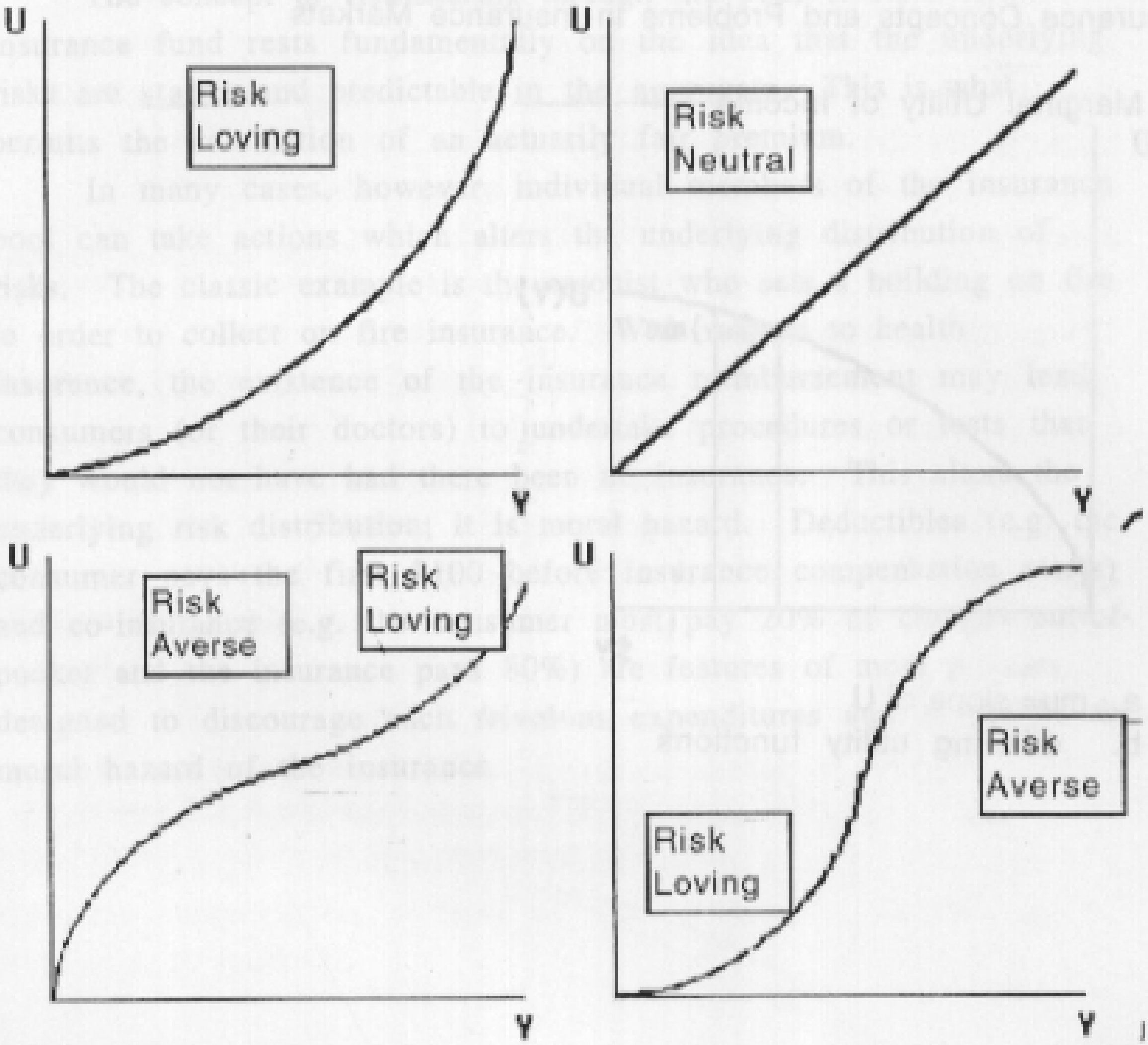
Insurance Concepts and Problems in Insurance Markets

1. Marginal Utility of Income



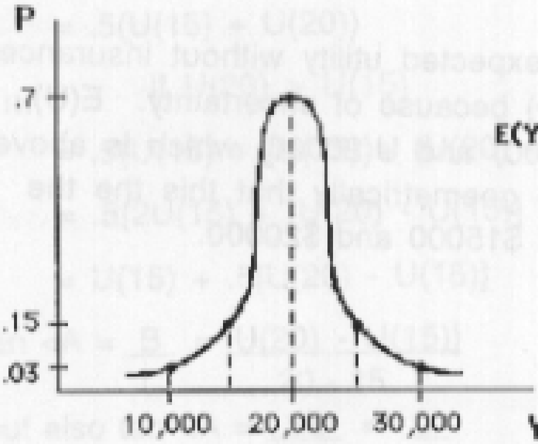
   a. mu= slope of U
   b. differing utility functions

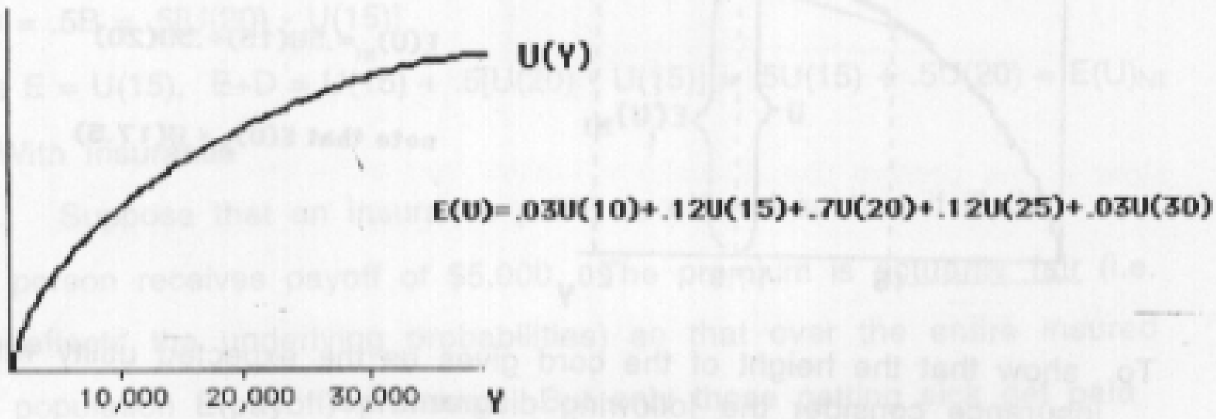


4. Risk and Insurance

recall σ_y is the measure of the the dispersion around the average income E(Y). Below E(Y) is 20,000 and σ_y is marked off by the dashed lines and is about 15,000.

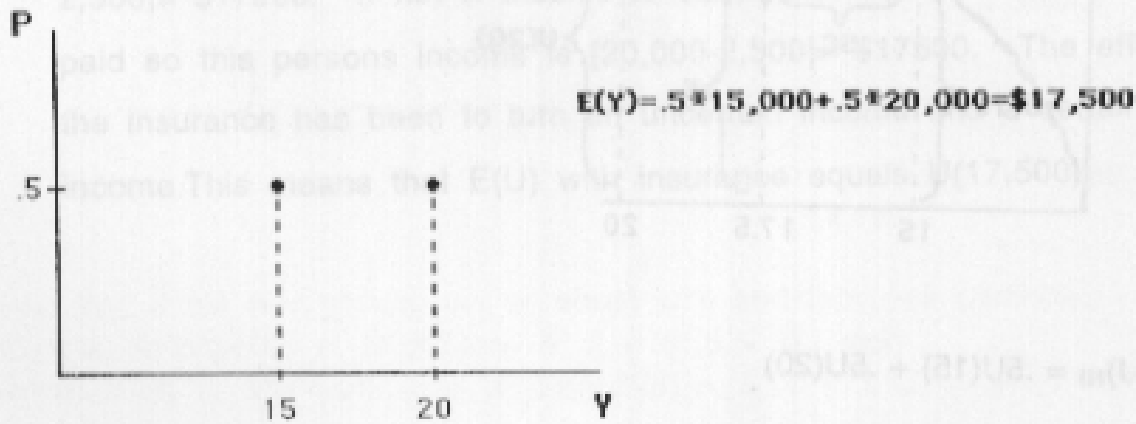
A. E(Y) and E(U) with and without insurance





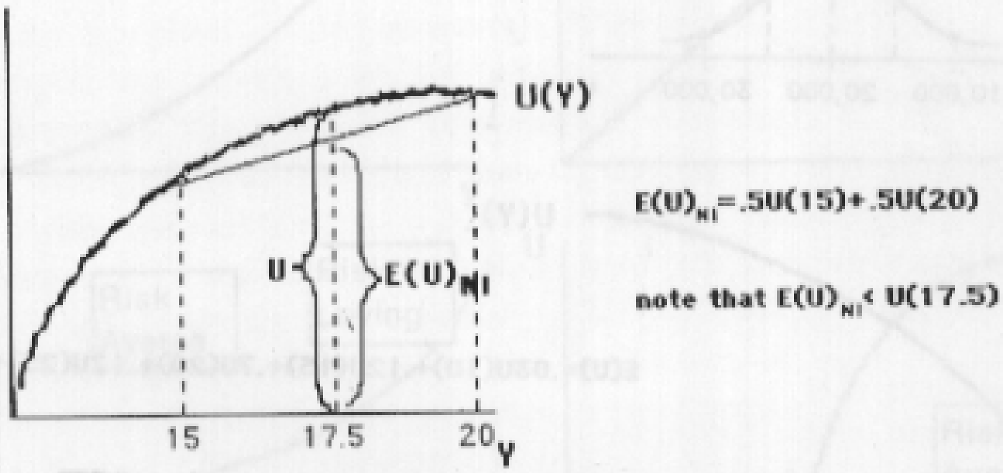
Simplify

Assume that there is a population for which only two states: The individual will earn $20,000 if no illness, $15,000 if subject to illness and everyone in that populatiion has an equal chance (p=.5) of being in either state. For any individual the E(Y) is $17500.

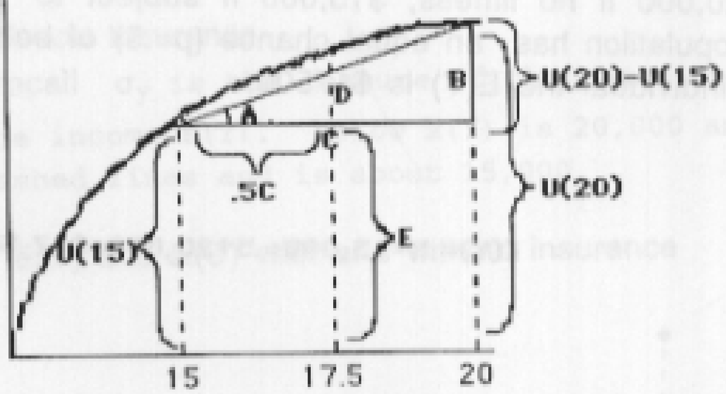


i. Without insurance

E(Y)=17,500. Let $E(U)_{NI}$ denote expected utility without insurance As illustrated below $E(U)_{NI} < U(17{,}500)$ because of uncertainty. $E(U)_{NI}$ is the point on the cord joining U(15000) and U(20000) which is above 17500. (On page it is demonstrated goemetrically that this the the E(U) when there is an equal chance of $15000 and $20000.



To show that the height of the cord gives us the expected utility without insurance consider the following diagram:



$E(U)_{NI} = .5U(15) + .5U(20)$

= .5(U(15) + U(20))

if U(20) > U(15)

= .5(U(15) + [U(15) + (U(20) - U(15))]

= .5(2U(15) + [U(20) - U(15)]

= U(15) + .5[U(20) - U(15)]

$\tan \angle A = \frac{B}{C} = \frac{[U(20) - U(15)]}{20 - 15}$

but also $\tan \angle A = \frac{.5B}{.5C} = \frac{D}{.5C}$

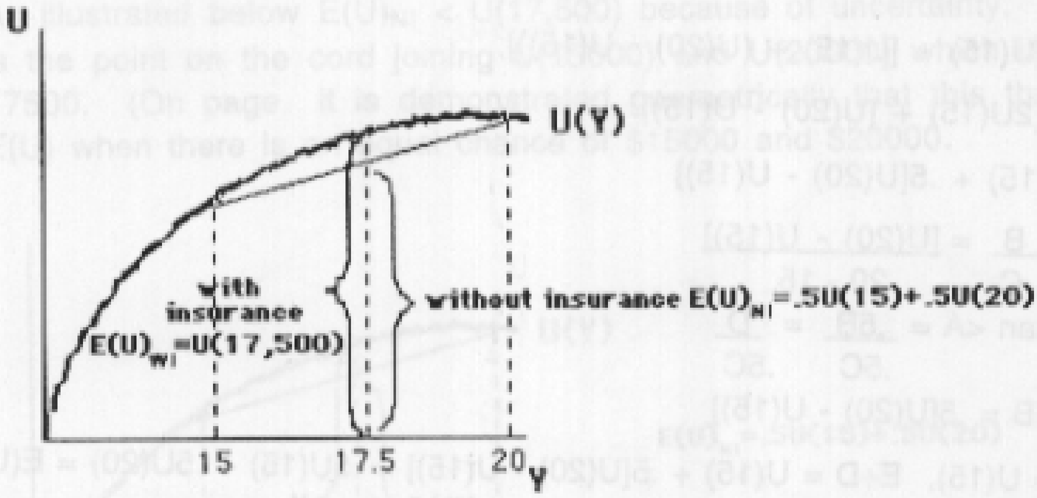
so D = .5B = .5[U(20) - U(15)]

since E = U(15), E+D = U(15) + .5[U(20) - U(15)] = .5U(15) + .5U(20) = $E(U)_{NI}$

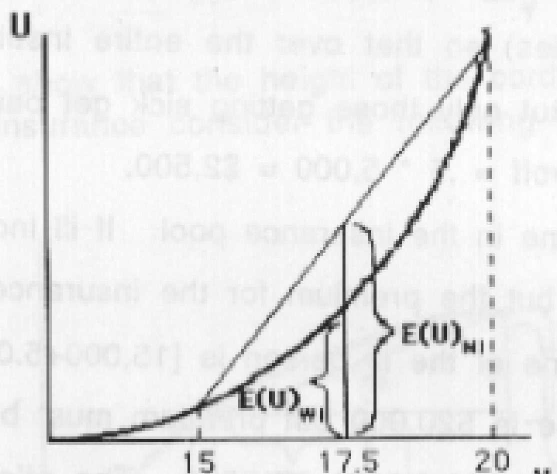
ii. With insurance

Suppose that an insurance policy is offered so that if ill the person receives payoff of $5,000. The premium is actuarily fair (i.e. reflects the underlying probabilities) so that over the entire insured population E(payoff)=premium. But only those getting sick get paid off so E(payoff) = p(payoff) * payoff = .5 * 5,000 = $2,500.

Now calculate E(Y) for everyone in the insurance pool. If ill income is $15,000 but payoff is $5,000 but the premium for the insurance must still be paid. So the income of the ill person is [15,000+5.000-2,500]= $17500. If not ill income is $20,000 but premium must be paid so this persons income is [20,000-2,500]= $17500. The effect of the insurance has been to turn an uncertain income into a certain income.This means that E(U) with insurance equals U(17,500)



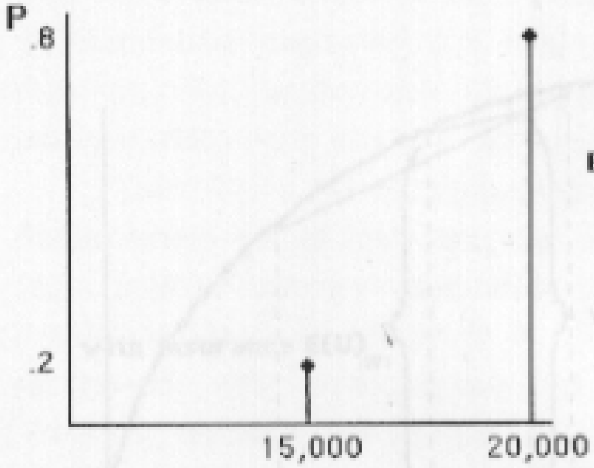
Note if one prefers risk, insurance makes one worse off



Differential Risk

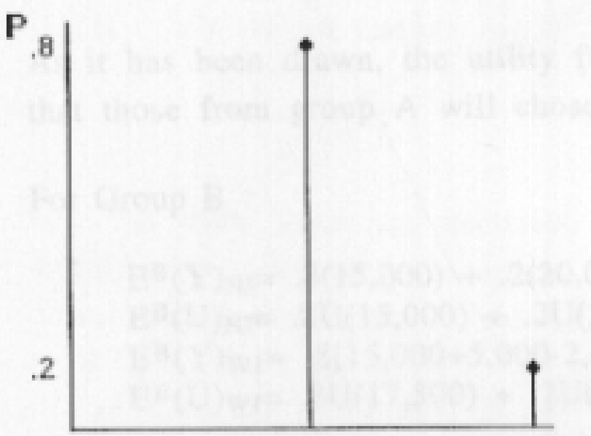
Suppose there are distinct groups in the population having different risk of illness.

Group A $p^A(\text{ill}) = .2$ $p^A(\text{not ill}) = .8$



$$E(Y_A) = .2*15{,}000 + .8*20{,}000 = 19{,}000$$

Group B $p^B(\text{ill}) = .8$ $p^B(\text{not ill}) = .2$



$$E(Y_B) = .8*15{,}000 + .2*20{,}000 = 16{,}000$$

Note that if the two groups are of equal size and they are combined

$p^{A+B}(\text{ill}) = .5*p^A(\text{ill}) + .5*p^B(\text{ill}) = .5*.2 + .5*.8 = .5$ and

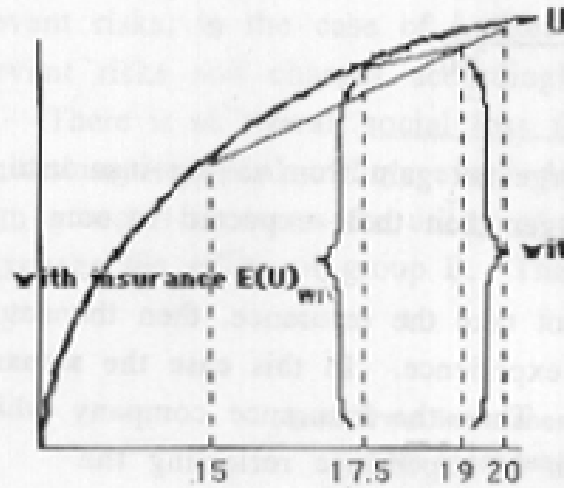
$p^{A+B}(\text{not ill}) = .5*p^A(\text{not ill}) + .5*p^B(\text{not ill}) = .5*.8 + .5*.2 = .5$

Therefore, for the <u>combined group</u> an actuarily fair premium will again be $2,500.

Now for Group A

$E^A(Y)_{NI}$= .2*(15,000) + .8*(20,000) = 19,000
$E^A(U)_{NI}$= .2U(15,000) + .8U(20,000)
$E^A(Y)_{WI}$= .2[15,000+5,000-2,500] + .8[20,000-2,500] = 17,500
$E^A(U)_{WI}$= U(17,500)

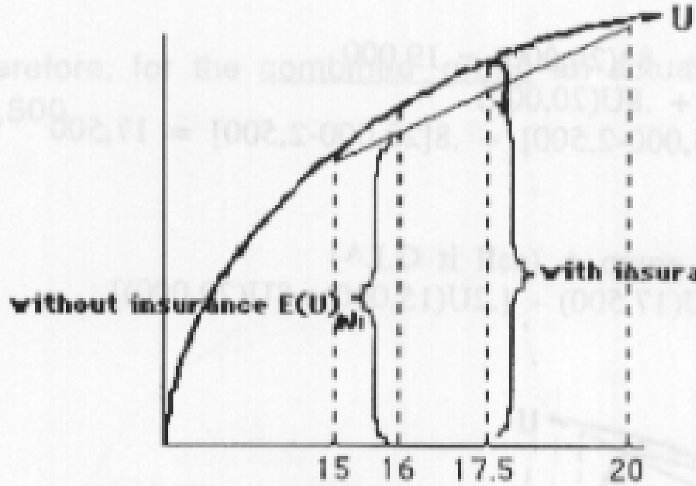
The gain from insurance for group A (call it G.I.^{A})
G.I.^{A}= $E^A(Y)_{WI}$. $E^B(Y)_{NI}$ = U(17,500) - [.2U(15,000)+.8U(20,000)]



As it has been drawn, the utility function G.I.^{A} is slightly negative so that those from group A will chose not to join the insurance pool.

For Group B

$E^B(Y)_{NI}$= .8(15,000) + .2(20,000) = 16,000
$E^B(U)_{NI}$= .8U(15,000) + .2U(20,000)
$E^B(Y)_{WI}$= .8[15,000+5,000-2,500] + .2[20,000-2,500] = 17,500
$E^B(U)_{WI}$= .8U(17,500) + .2U(17,500) = U(17,500)



It is clear that group B has a large net gain from taking insurance; it gains them a certain income larger than their expected income without insurance.

If in fact group A does not take the insurance, then the actual risk pool will reflect group B's experience. In this case the actuarity fair premium would be $4,000. Thus the insurance company which offered the policy in expectation of experience reflecting the combined group's loss experience would suffer a substantial loss: it's aggregate compensation to those ill would exceed by far the premiums it received.

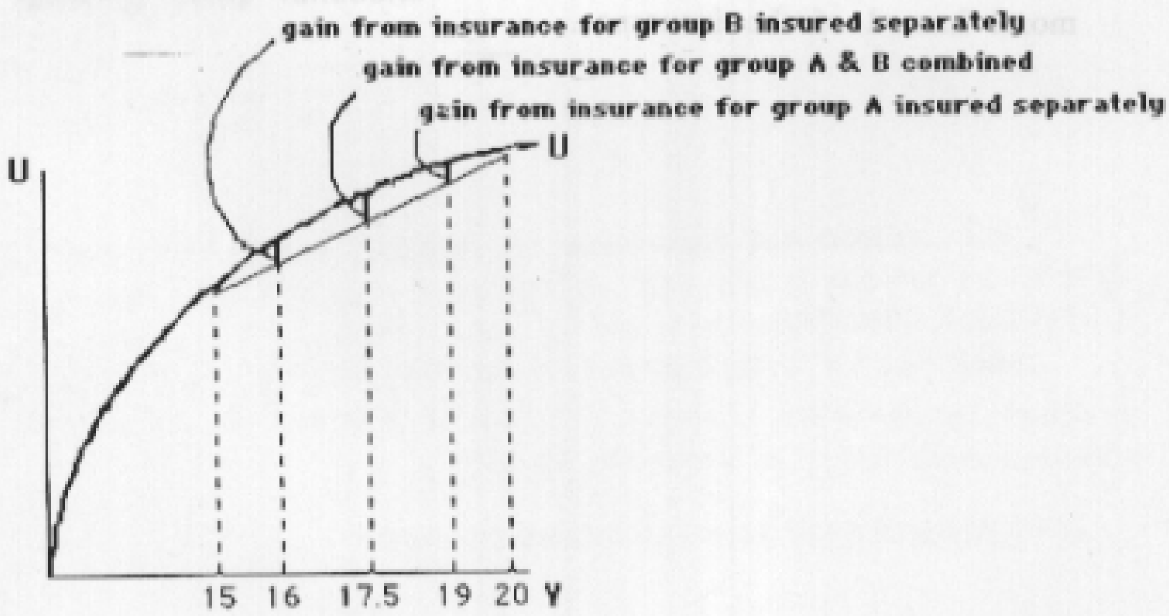
Adverse Selection

A situation such as that just described can arise when the insurer cannot adjust the premium adequately to the characteristics of each group because she does not have adequate information on which to differentiate members of group A from those of group B and adjust premiums accordingly. This is referred to as adverse selection: members of the group with high risk are (self) selected into the insurance pool, while members with low risk (self) select themselves out of the pool and the result is an adverse experience of compensation payments in excess of premiums.

Market Separation

When it is realized that there is a differential risk among groups, such as with A & B above, there are strong competitive incentives for insurance companies to try to separate the insurance markets for the two groups; if the insurer has information on characteristics differentiating the two groups she can charge different premiums according to expected losses. (Note that in the case of adverse selection the insurer lacks information on relevant differentiating characteristics while the consumer knows the relevant risks; in the case of market separation, the insurer know the relevant risks and charges accordingly.)

There is an overall social loss from market separation. Given diminishing marginal utility, every dollar redistributed to group A from group B increases the utility of group A by less than it decreases the utility of group B. This is illustrated in the following diagram:



Thus there may be some grounds for governments trying to prevent market separation. Such rules would clearly be a form of income redistribution. National health insurance is one means of preventing market separation.

Moral Hazard

The concept of risk-sharing through the pool of risks in an insurance fund rests fundamentally on the idea that the underlying risks are stable and predictable in the aggregate. This is what permits the calculation of an actuarily fair premium.

In many cases, however, individual members of the insurance pool can take actions which alters the underlying distribution of risks. The classic example is the arsonist who sets a building on fire in order to collect on fire insurance. With respect to health insurance, the existence of the insurance reimbursement may lead consumers (or their doctors) to undertake procedures or tests that they would not have had there been no insurance. This alters the underlying risk distribution; it is moral hazard. Deductibles (e.g. the consumer pays the first $100 before insurance compensation starts) and co-insurance (e.g. the consumer must pay 20% of charges out-of-pocket and the insurance pays 80%) are features of most policies designed to discourage such frivolous expenditures and to reduce the moral hazard of the insurance.