Demand and Supply of Health Insurance

University of Alabama

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Last Class

- Desirable Properties of Insurance
- Risk-Pooling Quality of Insurance
- Health Insurance Theory
- Example of Health Insurance, calculating Willingness to pay, expected loss, and risk premium

The Demand for Insurance

- Last class we showed how a risk-averse individual might benefit by purchasing insurance.
- Due to potential illness, this individual had an expected loss of income, suppose we calculated expected income to be: $E[M] = 32,000$.
- We calculated a Certainty Equivalent, or an amount of income the individual would be willing to accept in order to avoid risk. Suppose we calculated $CE = 30,000$.
- Despite expected income being higher than the CE, the individual is willing to accept a bit less to avoid taking on risk.
- Today we are going to talk about the demand for and supply of insurance, specifically how much insurance the individual should choose to purchase, and how the firm determines what price to charge.

The Demand for Insurance

The optimal purchase of insurance can be calculated by using the concepts of marginal benefits and marginal costs.

Suppose we have a risk-averse individual that makes \$20,000 per year. With a 5% chance, this individual's income will fall to \$10,000, and with the remaining 95% chance, the individual will remain whole. Further, assume once again square-root utility.

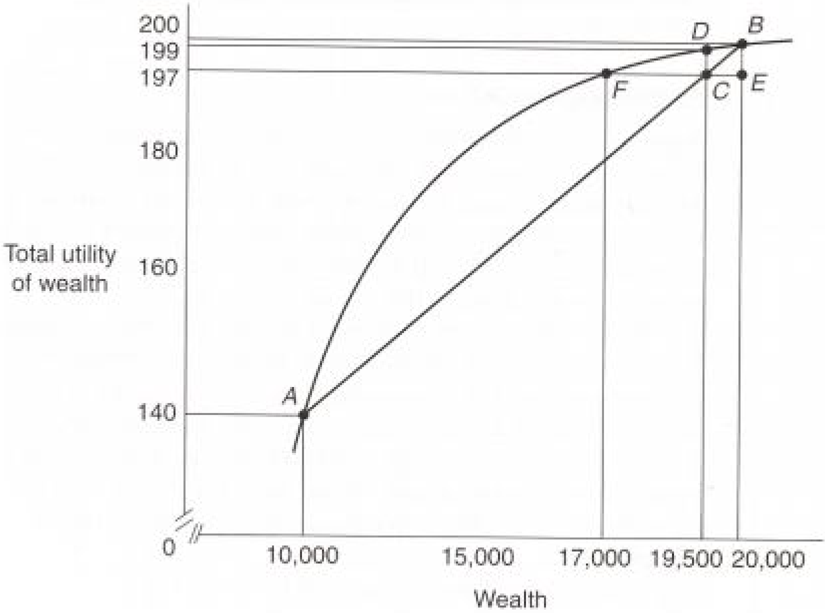
Let's calculate expected income and expected utility:

$$E[M] = 0.05 * 10,000 + 0.95 * 20,000 = 19,500$$

$$E[U] = 0.05 * utility\ of\ \$10,000 + 0.95 * utility\ of\ \$20,000$$

$$= 0.05 * 140 + 0.95 * 200 = 197$$

Graphically



How much Insurance?

Let's first consider an insurance policy that provides insurance covering losses up to \$500. Although it might hardly seem worth buying a \$500 insurance policy when the individual will lose \$10,000, it is a useful place to start.

Suppose the individual pays a 10% premium (\$50).

How Much Insurance?

Let's compute this individual's wealth if they are ill:

Insurance Worksheet - $ 500 coverage - Wealth if ill

	Original wealth	$20,000
less	Loss	$10,000
	Remainder	$10,000
plus	Insurance	$500
	Sum	$10,500
less	Premium	$50
or	**New** wealth	$10,450

Marginal Benefit: The expected marginal utility that the additional $450 brings.
Marginal Cost: The expected marginal utility that the $50 costs.
A person should increase coverage if $MB > MC$.

Marginal Cost and Marginal Benefit Curves

Why is the marginal benefit curve downward sloping?

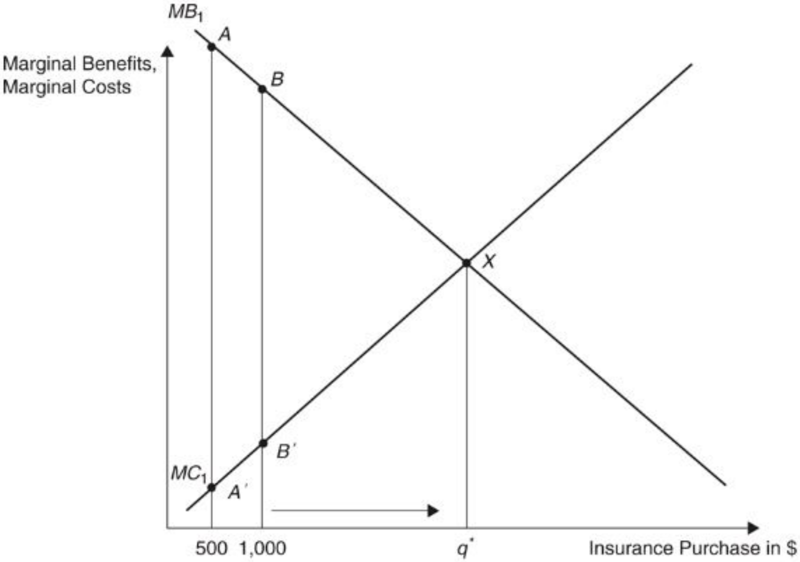
- Think about marginal benefits in terms of expected utility gained from purchasing insurance.
- For the first unit purchase of insurance, suppose the marginal benefit is $500
- For the second unit purchase of insurance, the gain is still $500, but due to the law of diminishing marginal utility of income, the consumer does not care quite as much about the second unit.
- Hence, it makes intuitive sense for marginal benefits to decline as more units of insurance are purchased, i.e. the marginal benefit curve is downward sloping.

Marginal Cost and Marginal Benefit Curves

Why is the marginal cost curve upward sloping

- Think about marginal costs in terms of expected utility that is lost due to payment of insurance premiums.
- For the first premium purchased of insurance, suppose the marginal cost is $50.
- For the second unit purchase of premium, the cost is still $50, but the consumer is now poorer, and the consumer cares more about the latter unit of utility lost. This is again due to the law of diminishing marginal utility of income.
- Hence, it makes intuitive sense for marginal costs to increase as more units of insurance are purchased, i.e. the marginal cost curve is upward sloping.

Marginal Benefit vs Marginal Cost



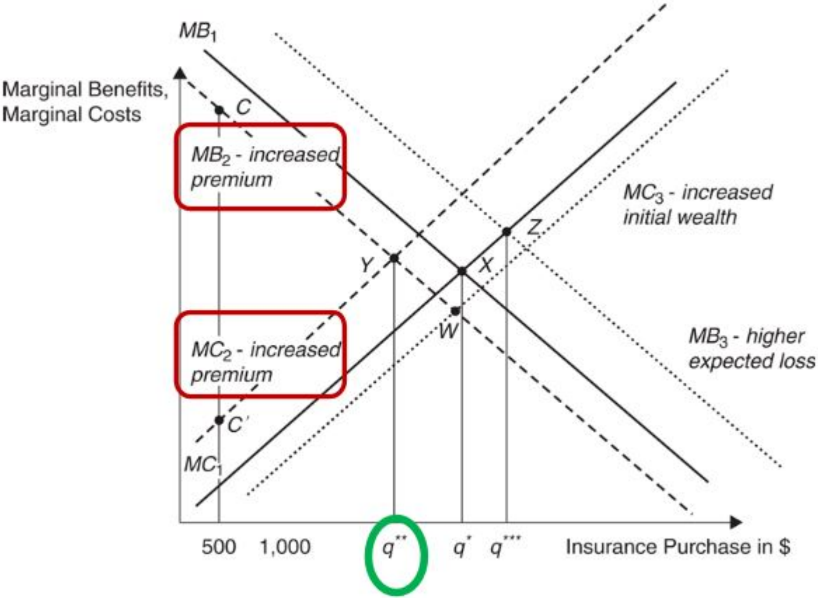
Changes in Premiums

Suppose the premium increases from $50 to $75

Insurance Worksheet - Higher premium - Wealth if ill		
	Original wealth	$20,000
less	Loss	$10,000
	Remainder	$10,000
plus	Insurance	$500
	Sum	$10,500
less	Premium	$75
or	**New** wealth	$10,425

Our wealth in the bad state is now lower by $25.
Higher premiums will shift the MB curve downward, and shift the MC curve upward.

Changes in Premiums

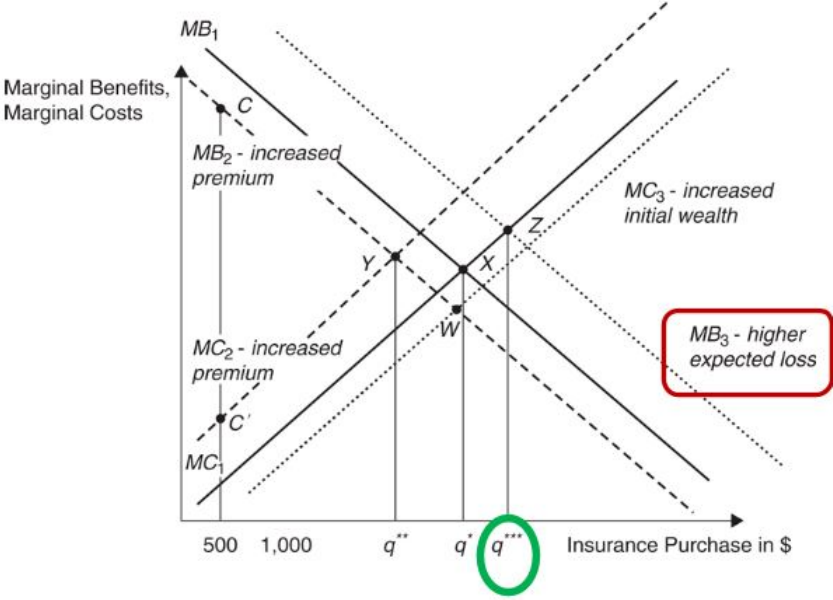


Changes in Expected Loss

Insurance Worksheet - Higher Expected Loss - Wealth if ill		
	Original wealth	$20,000
less	*New loss*	$15,000
	Remainder	$5,000
plus	Insurance	$500
	Sum	$5,500
less	Premium	$50
or	**New** wealth	$5,450

Increases in expected loss will cause the marginal benefit curve to shift upward.

Changes in Expected Loss



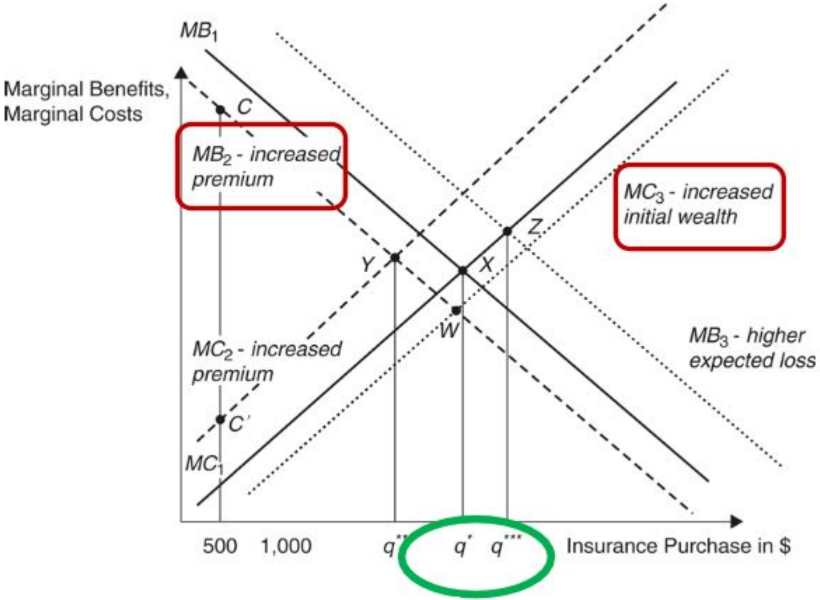
Changes in Wealth

Insurance Worksheet - Increased Wealth - Wealth if Ill

	Increased wealth	$25,000
less	*New loss*	$10,000
	Remainder	$15,000
plus	Insurance	$500
	Sum	$15,500
less	Premium	$50
or	**New** wealth	$15,450

Increases in wealth will cause both the MB and MC curves to shift downward.

Changes in Wealth



Implications

1. Insurance implies risk-aversion.
2. Willingness to pay for insurance reflects the probability of illness -a higher variance leads to larger demand for insurance.
3. Willingness to pay for insurance reflects losses from a bad state.
4. Since marginal utility of income declines with income, the poor should have a higher demand for insurance.

A Formal Model of Demand

Recall from intermediate micro: the demand curve is derived from the consumer's utility maximization problem. We can also derive the demand curve for insurance by using the utility maximization model. Suppose a consumer achieves utility from income in two possible states of the world: a good state and a bad state.

Utility if well: $U(M - cB)$

Utility if sick: $U(M - cB - S + B)$,

where M is income, c is cost of insurance per-unit, B is insurance benefit, and S is cost of sickness.

A Formal Model of Demand

Consumers choose a level of insurance benefits B to maximize expected utility given that p represents the probability of illness.

$$\underset{\{B\}}{\textbf{Maximize}}\ (1-p)\ U(M-cB)+p\ U(M-S+(1-c)B)$$

To maximize utility, we take the first-order condition with respect to B and set it equal to zero:

$$\frac{\partial}{\partial B}=(1-p)\ U'(M-cB)*(-c)+p\ U'(M-S+(1-c)B)*(1-c))=0$$

Rearranging we have:

$$(1-p)\ c\ U'(M-cB)=p\ (1-c)\ U'(M-S+(1-c)B),$$

where the LHS represents the marginal cost per unit of insurance and the RHS represents the marginal benefit per unit of insurance.

The Supply of Insurance

For now, let's assume that the market for health insurance is a perfectly competitive market.

In the long run in perfect competition, economic profits $=$ 0

Why?

Why would firms continue operate in the long run if economic profits were zero?

Note that if economic profits were greater than zero, then other competitors would enter the market as there are positive economic profits to be made.

Profits for Insurance Firms

What might the profit function for an insurance firm look like?

$$\pi = \textit{Revenues} - \textit{Costs},$$

where revenues are premiums paid to insurance companies, and costs are insurance payouts and administrative/overhead costs to operate day-to-day. Note that payouts occur only after losses, while overhead is paid regardless of losses. Then

$$\pi = \textit{Premiums} - \textit{Overhead} - \textit{Payouts}$$

Example

$$\pi = \mathit{Premiums} - \mathit{Overhead} - \mathit{Payouts}$$

Consider a situation in which the probability of illness of 50% and the insurance firm must payout $1,000 in the event of an illness. Moreover, this firm charges premiums that are 60% of the payout, and overhead costs are $8 per enrollee. Then,

$$\pi = \$600 - \$8 - 0.5 * \$1,000$$

So profit = $92 per enrollee.

Positive Profits

Note that our insurance firm in this example is making positive profits. So what will competing firms do?

- Other insurance firms will enter the market and undercut our price in an effort to make economic profits.
- New firms enter until economics profits are zero.

Note that $\pi = 0 \implies Premiums \; = \; Payouts \; + \; Overhead$

Since $\pi = Premiums \; - \; Payouts \; - \; Overhead$

When will undercutting stop?

Suppose a firm on the outside looking in sees that we are making \$92 of profit per enrollee. They will enter the market and charge a lower premium than us. Recall that we charged a premium of 60% of the payout. What if they charge a premium of 55%? Then their profit will be:

$$\pi = \$550 - \$8 - 0.5 * \$1,000 = \$42 \textit{ per enrollee}.$$

Outside firms will continue to enter the market until the premium is approximately 50.8% of the payout. Then, under perfect competition,

$$\pi = \$508 - \$8 - 0.5 * \$1,000 = 0 \textit{ per enrollee}$$

Probability of Loss

We can show that the premium is directly tied to the probability that an individual experiences illness. Suppose revenue is given by aq, where a is the premium in fractional terms and q is the payout. Further, suppose that costs are given by pq+t, where p represents the probability of illness, q is the payout, and t are the loading fees or administrative overhead. Then,

$$profits = revenue(aq) - cost(pq + t) = aq - pq - t$$

In PC, profits = 0, so

$$0 = aq - pq - t$$

Probability of Loss

$$0 = aq - pq - t$$

Rearranging gives,

$$aq = pq + t$$

Finally, dividing both sides by the payout gives

$$a = p + t/q$$

This is the competitive premium charged by insurers. The competitive premium a is a function of the probability of illness, p plus the processing, or loading costs as a percentage of the policy value q. If t/q goes to zero, then a=p. This refers to the "actuarial-fair" insurance rate in which the premium is tied only to the probability of loss.

Full Insurance

$$(1-p)\ c\ U'(M-cB) = p\ (1-c)\ U'(M-S+(1-c)B),$$

Recall from the model of demand, MC = MB.

We just showed that under perfect competition, the cost as a percent of the benefit, c, must be equal to the probability of illness, p, i.e. c=p. Then from the expression above,

$$U'(M-cB) = U'(M-S+(1-c)B)$$

In order for this expression to hold with equality, S must be equal to B. So under perfect competition, a person will purchase full insurance, i.e. B=S.

Moral Hazard

Thus far we have discussed the demand and supply of insurance when losses occur at random. What we observe in the real world, however, is the presence of moral hazard due to insurance. Moral hazard occurs when the pooling of risks leads to decreased marginal costs for the services.

In other words, moral hazard is the tendency of a person who is imperfectly monitored to engage in dishonest or otherwise undesirable behavior.

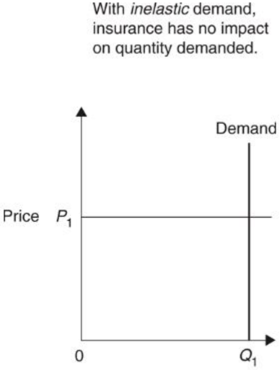
Moral Hazard is Everywhere

- Financial firms that gamble investors' money (because they will be bailed out if they lose).
- General contractors that don't finish jobs (because they have already been payed).
- Workers that sometimes shirk their responsibilities (because employers cannot continuously monitor their performance).
- Drivers may be more risky while on the road (when the insurance company will replace the car if wrecked).
- Someone may not try as hard to stay healthy (when the insurance company foots the medical bills).

Inelastic Demand

Suppose that an individual faces that probability of contracting Type I diabetes, and hence will die without insulin. This consumer's demand for insulin may be perfectly inelastic, that is, unresponsive to its price.

- P(Sick) = 0.5
- If a condition with inelastic demand, actuarially fair price for insurance is $0.5 * P_1 * Q_1$

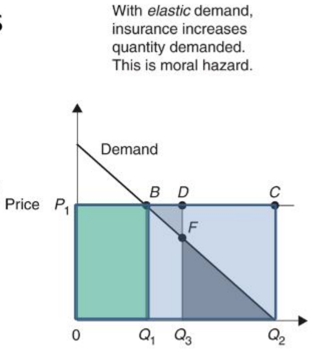


A. Inelastic demand

Elastic Demand

Consider instead a medical condition with perhaps more demand elasticity than Type I diabetes. Preventative care may fall into this category.

- With elastic demand, Q_2 is demanded
- Total cost is $0P_1CQ_2$
- If insurance company charges $0.5*P_1*Q_1$ they go out of business
- If insurance company charges $0.5*P_1*Q_2$ they may not have customers



B. Elastic demand

How to solve this problem?

It is clear that due to moral hazard, in some instances it may be appropriate for the insurance company to charge a little higher a premium. Moreover, we might use demand price elasticity as an indicator of the potential for moral hazard. Some potential solutions to moral hazard may be:

1. Deeper (more complete) coverage for services with more inelastic demand.

2. Deductibles and coinsurance

3. Development of insurance first for those services with the most inelastic demand, and only later for those with more elastic demand.

Effects of Deductibles

There are a couple of different potential effects of deductibles:

1. If a deductible is relatively small, then it will have no effect on individual usage. People will pay the relatively small deductible, continue to consume medical care, and moral hazard will remain a problem.

2. If a deductible is relatively large, then individuals will be deterred from using insurance. People will be more likely to "self-insure" under this situation. People will be more likely to consume the amount of medical care that they would have prior to purchasing insurance.

Adverse Selection

- A related concept to moral hazard is an issue of information asymmetry known as Adverse Selection.
- Adverse Selection occurs when the seller of a product knows more about the product than the buyer.
- The textbook example of adverse selection is from George Akerlof's 1970 paper "The Market for Lemons: Quality Uncertainty and the Market Mechanism."
- Akerlof won the Nobel Prize in Economics for this paper, despite the fact that the paper was rejected by three different journals for its "triviality."

Adverse Selection

Consider the market for used cars:

- There are two different types of cars in the used car market: Lemons and Peaches.
- Lemons are bad quality cars, while peaches are good quality cars.
- The seller of the car knows the car's true quality, but the buyer does not (this is information asymmetry).
- Buyers have a belief about the probability of a car being a lemon or a peach, and based on this belief, they form an expected value of the car. This expected value is the buyer's willingness to pay for the car.
- Because this WTP is less than the value of a peach, the only car sellers that go to the market are those of Lemons. This is adverse selection, sellers of lemons "adversely select" into the market. Then, buyers avoid the market altogether.

Adverse Selection

Adverse Selection also occurs in the market for health insurance:

- Buyers of health insurance know more about their own health than health insurance companies (this is the information asymmetry).
- People with hidden health problems are more likely to buy health insurance (this is adverse selection). Sick people "adversely select" into the health insurance market.
- Because sick people are more likely to enter the market, insurance providers charge a premium that reflects the costs of a sicker-than-average person.
- Because of this higher premium, healthy people are discouraged from purchasing health insurance.

Adverse Selection

Consider a simple example:

There are three people in the world: Person A, Person B, and Person C. A has expected medical costs of \$500, B has expected medical costs of \$1,000, and C has expected medical costs of \$1,500.

The insurance company knows the expected medical costs, but it does not know which of the costs is associated with each of the people. The expected medical cost of the three people is:

$$E[cost] = \frac{1}{3}\left(\$500\right) + \frac{1}{3}\left(\$1,000\right) + \frac{1}{3}\left(\$1,500\right) = \$1,000$$

Adverse Selection

The insurance company, knowing the expected medical costs, charges a premium of $1,000.

Who buys insurance?

- Person A does not buy insurance as the premium is twice as much as his or her expected loss of $500.
- Then only B and C purchase insurance and the expected medical costs are now $1,250 with only the two "high-cost" individuals.

The next year, the insurance company, knowing the updated expected medical costs, charges a premium of $1,250.

Who buys insurance?

- Person B does not buy insurance as the premium is larger than his or her expected loss of $1,000.
- Then only C purchases insurance and the expected costs are now $1,500 with only the single "high-cost" individual.

Adverse Selection

Eventually, only sick, high-cost individuals are purchasing insurance. These sick people are adversely selecting into the market for insurance. In this simple example:

1. Person A and Person B would have been willing to purchase insurance at certain prices.

2. Insurance companies would have been willing to sell contracts at certain prices.

Hence, due to Adverse Selection, beneficial transactions have been left on the table. This creates an inefficiency.

Solutions to Adverse Selection

1. Screening
   - But is screening really feasible?

2. Pre-existing conditions clauses
   - Prior to the ACA, insurance companies could deny coverage to those that had pre-existing conditions. However, the ACA prevents companies from denying coverage based on this.

3. Individual Mandate
   - Force everyone to purchase insurance.
   - If healthy people are forced to purchase insurance, then sick people are not able to adversely select into the insurance market.
   - But what if healthy, lower/middle-class households cannot afford this mandated insurance? This is the reason behind providing certain households with subsidies to aid in purchasing insurance.

Next Class

- Rothschild & Stiglitz (1976)
- RAND Health Insurance Experiment