

# Demand and Supply of Health Insurance

## Chapter 8

# WHAT IS INSURANCE?

- Insurance provides a way for individuals to smooth consumption over different states of the world.
  - For example, suppose you have a good state of the world and a bad state of the world. Your consumption in the good state of the world is much higher than that in the bad state. However, you can enter into a contract for a price (a premium) that allows you to increase your consumption in the bad state of the world, but does lower your consumption in the good state of the world (because of the premium you pay).
  - Whether it makes sense for someone to buy the contract will depend on their preferences as well as the premium, we will discuss that later in the lecture today.

# Insurance in healthcare markets

- In most countries, individuals do not pay for healthcare directly. A government program or an insurance company will pay for most the care and perhaps the patient will only pay a small portion of the bill.
- Healthcare expenditures can be quite large and it cannot be determined ahead of time when they will be needed, so insurance can provide an important service to consumers.

# Risk versus Uncertainty

- Economists distinguish between risk and uncertainty:
  - Risk is something you can quantify, the probability that you have a car accident is 0.02
  - Uncertainty is something you cannot quantify, e.g., suppose the U.S. government shuts down doesn't pay the interest in its debt and drags the world economy into global apocalypse
- With uncertainty there is nothing you can do except hope for the best, but with risk you can turn to insurance to protect yourself from losses

# Insurance Terminology

- *Premium, Coverage*—When people buy insurance policies, they typically pay a given premium for a given amount of coverage should the event occur.
- *Exclusions*—Services or conditions not covered by the insurance policy, such as cosmetic or experimental treatments.

# More Insurance Terminology

- *Deductible*—With many policies, some amount of the health care cost is paid by the insured person in the form of a deductible, irrespective of coinsurance. In a sense, the insurance does not apply until the consumer pays the deductible. Deductibles may be applied toward individual claims, or, often in the case of health insurance, they may be applied only to a certain amount of total charges in any given year.

# More Insurance Terminology

- *Coinsurance and Copayment*—Many insurance policies, particularly in the health insurance industry, require that when events occur, the insured person share the loss through copayments. This percentage paid by the insured person is the coinsurance rate. With a 20 percent coinsurance rate, an insured person, for example, would be liable (out of pocket) for a \$30 copayment out of a \$150 charge. The insurance company pays the remainder.

# Even More Insurance Terminology

- *Limitations*—Maximum coverages provided by insurance policies. For example, a policy may provide a maximum of \$3 million lifetime coverage.
- *Pre-Existing Conditions*—Medical problems not covered if the problems existed prior to issuance of insurance policy. Examples here might include pregnancy, cancer, or HIV/AIDS.



# RISK AND INSURANCE

## Expected Value

- Suppose Elizabeth considers playing a game in which a coin will be flipped. If it comes up heads, Elizabeth will win \$1; if it comes up tails, she will win nothing.
- With an honest coin, the probability of heads is one-half (0.5), as is the probability of tails. The expected value, sometimes called the expected return, is:

$$\text{ER} = (\text{probability of heads}) \times (\text{return if heads, } \$1) + (\text{probability of tails}) \times (\text{return if tails, } 0) = \$0.50$$

# In General

- With  $n$  outcomes, expected value  $E$  is written as:

$$E = p_1R_1 + p_2R_2 + \dots + p_nR_n$$

- where  $p_i$  is the probability of outcome  $i$ , (that is  $p_1$  or  $p_2$ , through  $p_n$ ) and  $R_i$  is the return if outcome  $i$  occurs. The sum of the probabilities  $p_i$  equals 1.

# Actuarially Fair Insurance Policy

- When the expected benefits paid out by the insurance company are equal to the premiums taken in by the company the insurance policy is called an *actuarially fair insurance policy*.

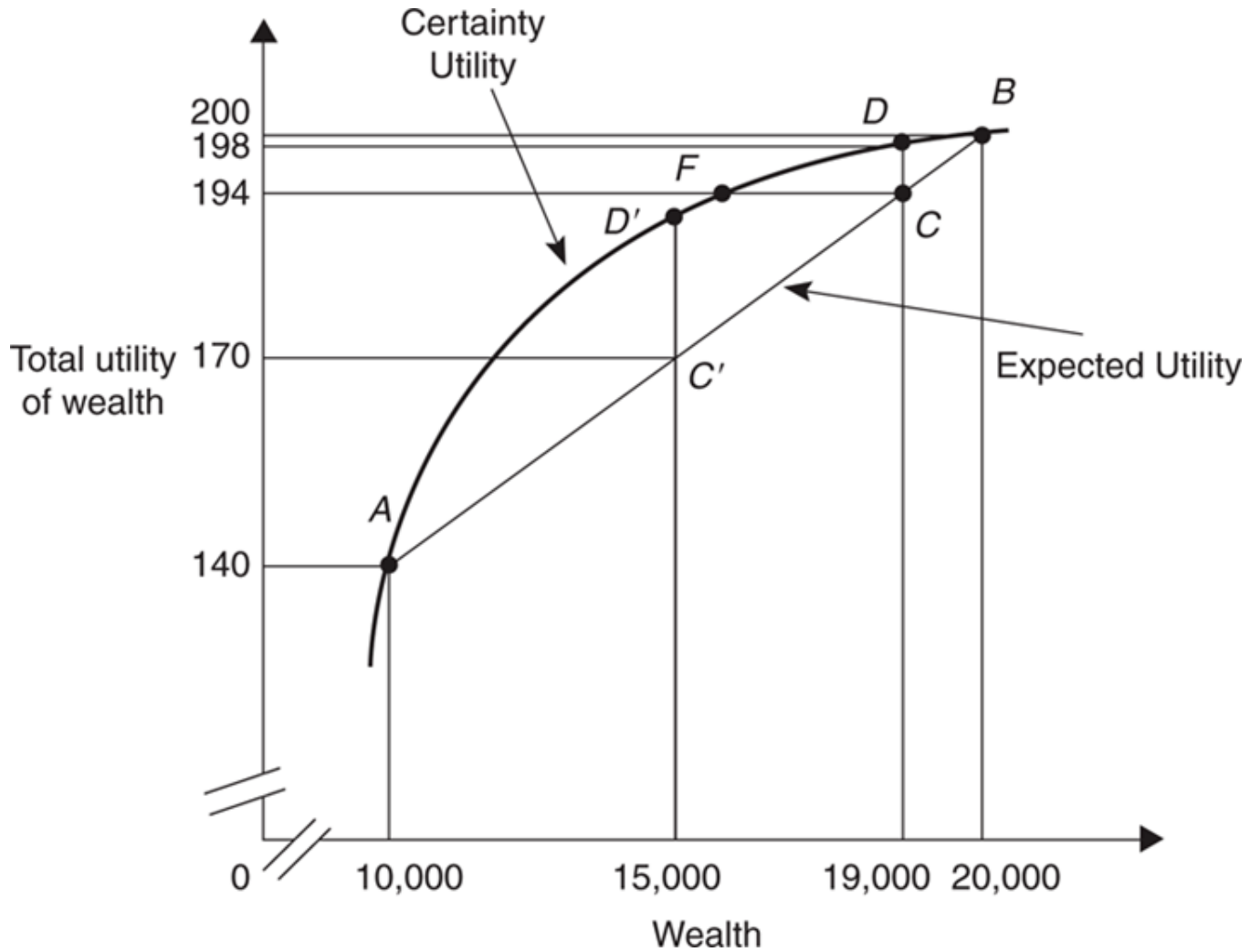
# Marginal Utility of Wealth and Risk Aversion

- Suppose you have actuarially fair game but choose not to play because the disutility of losing money may exceed the utility of winning a similar amount.
- For example, the martingale system for even bets in roulette (black vs red; low vs high, even vs odd)
  - 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, ....
  - 10, 20, 40, 80, 160, 320, 640, 1280, 2560, ...
  - 1000, 2000, 4000, 8000, 16000, 32000, 64000, 128000, ...

# Utility of Wealth

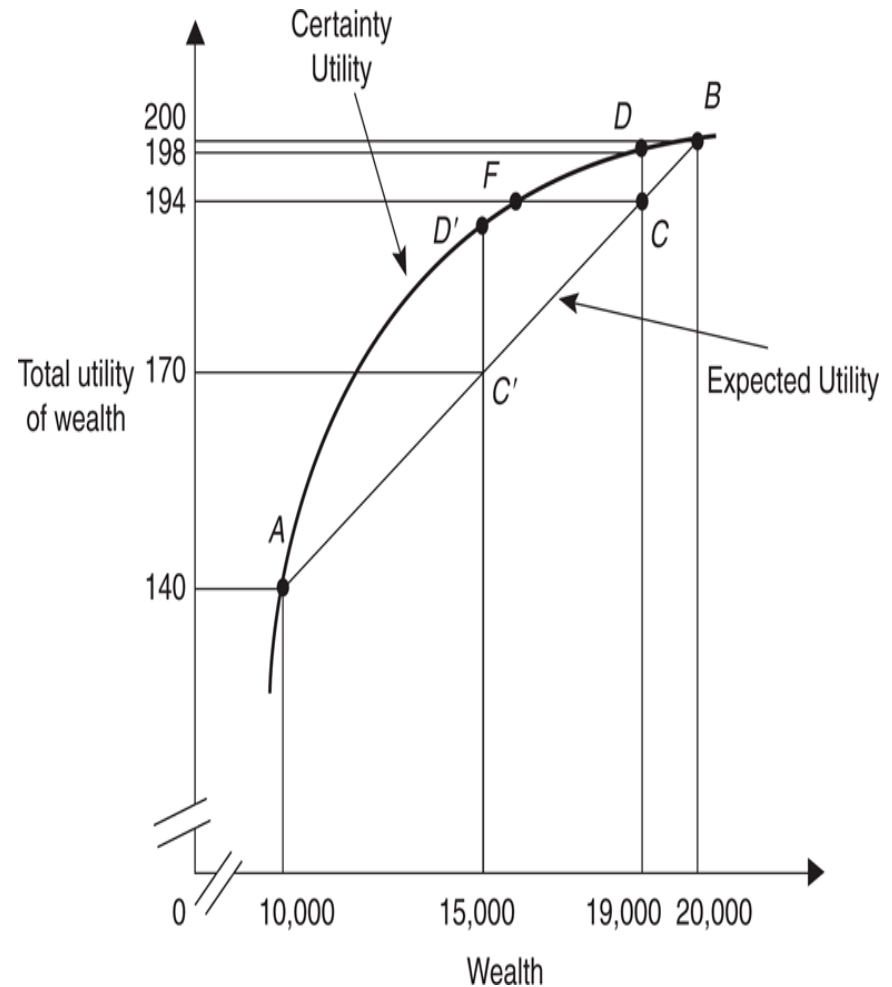
- The utility of wealth function pictured on the describes an individual who is risk averse.

# Expected Utility



# Purchasing Insurance

- Suppose that Elizabeth can buy an insurance policy costing \$1,000 per year that will maintain her wealth irrespective of her health.
- Is it a good buy? We see that at a net wealth of \$19,000, which equals her initial wealth minus the insurance premium, her certainty utility is 198. Elizabeth is better off at point *D* than at point *C*, as shown by the fact that point *D* gives the higher utility.



# Fake numerical example

- The following numerical example corresponds to the previous diagrams; State 1 is the good state and wealth is 20000 with probability 0.90 and State 2 is the bad state with wealth 10000 and probability 0.10;  $u(w)$  is the utility function
- Generally, the functional form for  $u(w)$  is specified, but this example is based on the numbers in the text where no functional form is specified



# Fake numerical example

$$\begin{aligned}EU &= p * u(20000) + (1-p) * u(10000) \\ &= 0.9 * u(20000) + 0.1 * u(10000) \\ &= 0.90(200) + 0.1(140) \\ &= 180 + 14 \\ &= 194\end{aligned}$$

# Real numerical example

- State 1 is the good state and wealth is 20000 with probability 0.95 and State 2 is the bad state with wealth 10000 and probability 0.05;  $u(w)$  is the utility function and is such that  $u(w)=\ln(w)$
- log preferences are quite common, some other choices might include quadratic preferences  $u(w)=w^2$

# Real Numerical Example

$$\begin{aligned}EU &= p * \ln(20000) + (1-p) * \ln(10000) \\ &= 0.95 * \ln(20000) + 0.05 * \ln(10000) \\ &= 0.95 * 9.8035 + 0.05 * 9.2103 \\ &= 9.8688\end{aligned}$$

- Mathematically, an individual would buy insurance if the expected utility the person gets if they buy insurance is bigger than the expected utility if they just faced the potential states of the world without insurance
  - $U(\text{Wealth in good state} - \text{premium}) > EU$

# What's the Most An Individual Would Pay for Insurance

- Using the figures from the real numerical example discussed in the preceding slides, We know the expected utility, the wealth in the good state and that the fact that the person will buy insurance if  $U(\text{Wealth in good state} - \text{premium}) > EU$ , you can solve for the most someone would pay for insurance.

$$E(u(w)) = U(20000 - x)$$

Where  $x$  is the maximum premium

$$E(u(w)) = \ln(20000 - x)$$

Substituting in for  $E(u(w))$  which was computed earlier

# What's the Most An Individual Would Pay for Insurance

- $9.8688 = \ln(20000 - x)$
- Using the fact that  $\ln e^x = x$  and  $e^{\ln x} = x$ , we can rewrite the above equation as  $e^{9.8688} = (20000 -$

# Another Common Functional Form

- Constant Relative Risk Aversion (CRRA) Utility is also a common choice, where the utility of wealth can be expressed as  $u(w) = \frac{w^{1-\gamma}}{1-\gamma}$ , where  $\gamma$  denotes the coefficient of relative risk aversion for an individual
- The risk aversion of the person is measured by  $\gamma$  and  $\gamma$  takes values bigger than 0. However, there are two special cases.

- First, if  $\gamma=1$  then  $u(w) = \frac{w^{1-\gamma}}{1-\gamma}$  becomes  $u(w)=\ln(w)$ . More specifically, by l'Hopital's rule  $\lim_{\gamma \rightarrow 1} \frac{w^{1-\gamma}}{1-\gamma} = \ln(w)$
- Second, if  $\gamma=0$  then  $u(w)=\frac{w^{1-\gamma}}{1-\gamma}$  becomes  $u(w)=w$ , or in other words the individual is risk neutral.



- Empirical studies tend to find estimates of  $\gamma$  that range from 1 to 4, with 2 being the average estimate.
  - The bigger the estimate of  $\gamma$  the more risk averse someone is.

# What Does this Analysis Tell Us?

- Insurance can be sold only in circumstances where the consumer is risk averse.
- Expected utility is an average measure.
- If insurance companies charge more than the actuarially fair premium, people will have less expected wealth from insuring than from not insuring. Even though people will have less wealth as a result of their purchases of insurance, the increased well-being comes from the elimination of risk.
- The willingness to buy insurance is related to the distance between the utility curve and the expected utility line.

# THE DEMAND FOR INSURANCE

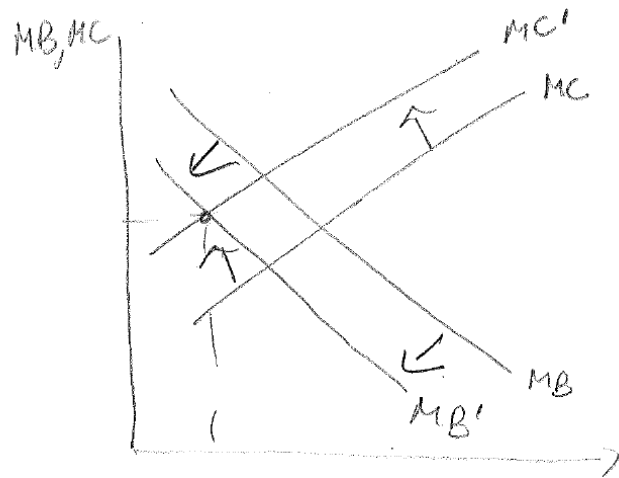
## How Much Insurance?

- We address the optimal purchase of insurance by using the concepts of marginal benefits and marginal costs.

# The Effect of a Change in ... on Individual's Level of Insurance

- Increase in premium
- Increase in expected loss
- Increase in wealth

# The Effects of an increase in premium



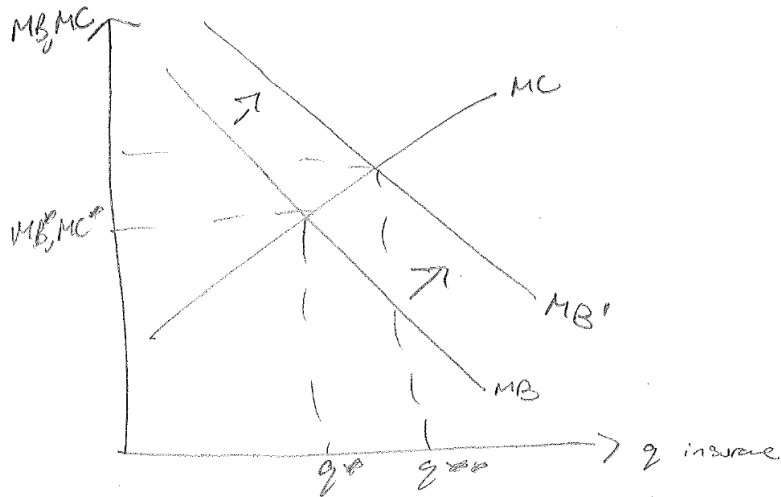
- premium increase  $\uparrow$
- $\Rightarrow$  opportunity cost of buying insurance increases
- $\Rightarrow$  MB of buying insurance falls

give up more of my wealth with the higher premium, so since I have lower wealth the MB I get from coverage falls

new equilibrium  
higher MB, MC  
less insurance

# The effects of an increase in expected loss

- increase in expected loss
- increase in probability of loss

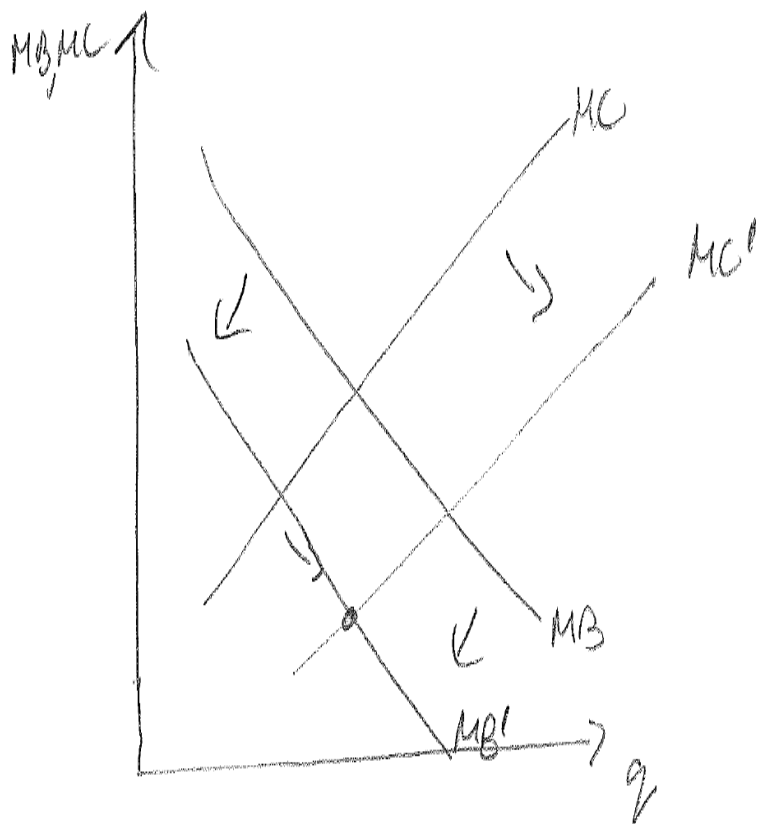


no change in MC, opportunity cost of buying insurance hasn't changed

MB increases

- loss I face is larger so benefits I get from coverage increase
- $\rightarrow$  insurance protects more of my wealth.

# The effects of an increase in wealth



Wealth increases

- opportunity cost of buying insurance falls (give up less when buy insurance)

Marginal benefit from coverage falls

- loss is fixed
- so benefits you get from insurance fall, loss effects a smaller share of your wealth so get smaller benefits
- curves shift in opposite direction harder to know where equilibrium will be in the diagram.

# THE CASE OF MORAL HAZARD

## What is Moral Hazard?

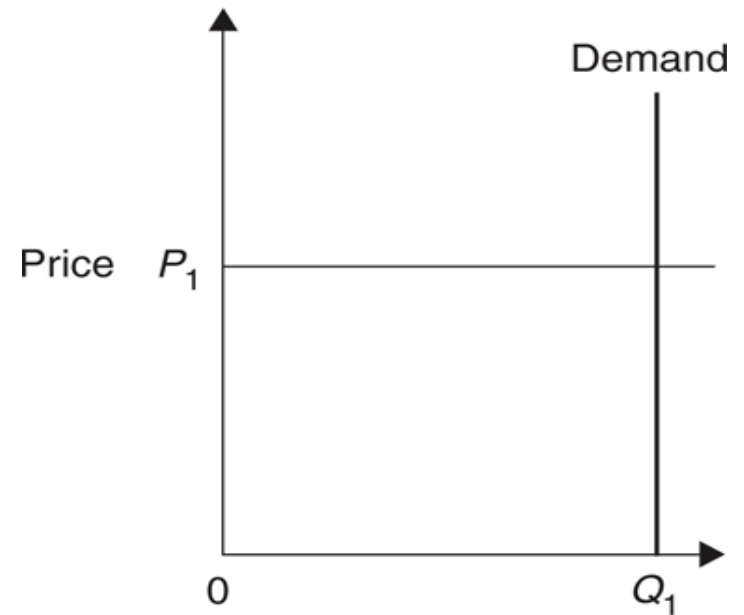
- So far, we have assumed that the amount of the loss was fixed—that it did not change merely because people bought insurance. However, in many cases, buying insurance lowers the price per unit of service at the time that the services are purchased. If people purchase more service due to insurance, then many of the insurance propositions just presented must be modified.



# Figure 8-4 Demand for Care and Moral Hazard

- Suppose Elizabeth faces a probability of .5 that she will contract Type I diabetes and without insulin, she will die.
- Her demand for insulin will be perfectly inelastic and she will purchase insurance to cover expenditures  $P_1Q_1$ .

With *inelastic* demand, insurance has no impact on quantity demanded.

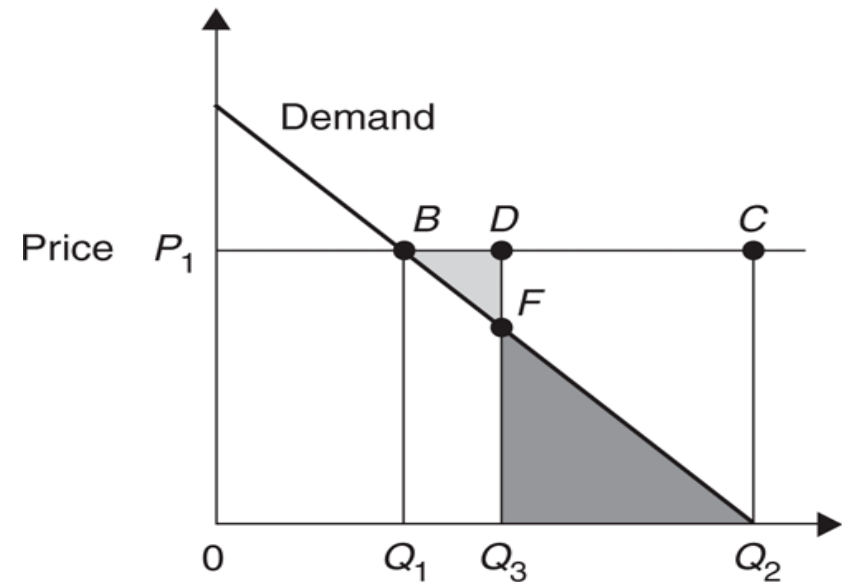


A. Inelastic demand

# Figure 8-4 Demand for Care and Moral Hazard

- Consider, instead, Elizabeth's demand for dermatological care.
- If she purchases insurance that pays her entire loss, then this insurance makes treatment (ignoring time costs) free. Because the marginal price to Elizabeth is zero, she would demand  $Q_2$  units of care for a total cost of care of  $P_1 Q_2$ .

With *elastic* demand, insurance increases quantity demanded. This is moral hazard.



B. Elastic demand

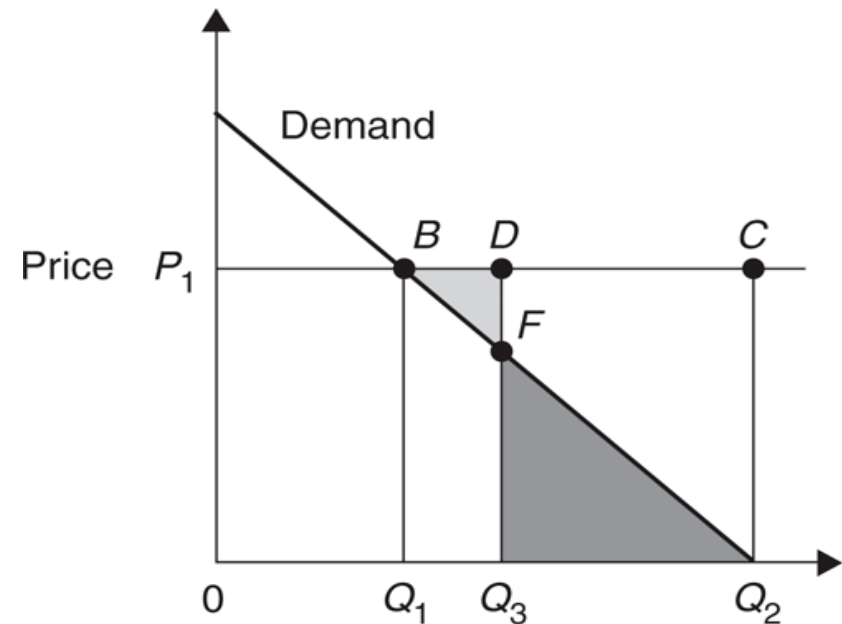
Moral Hazard

# Effects of Coinsurance and Deductibles

FIGURE 8-4 Demand for Care and Moral Hazard

- A deductible of \$700 would mean that Elizabeth must pay the first \$700 of expenses out-of-pocket. This would lead her to purchase  $Q_3$  units of health care rather than  $Q_2$ , therefore the introduction of deductibles and counteract the impact of moral hazard.

With *elastic* demand, insurance increases quantity demanded. This is moral hazard.



B. Elastic demand

# HEALTH INSURANCE AND THE EFFICIENT ALLOCATION OF RESOURCES

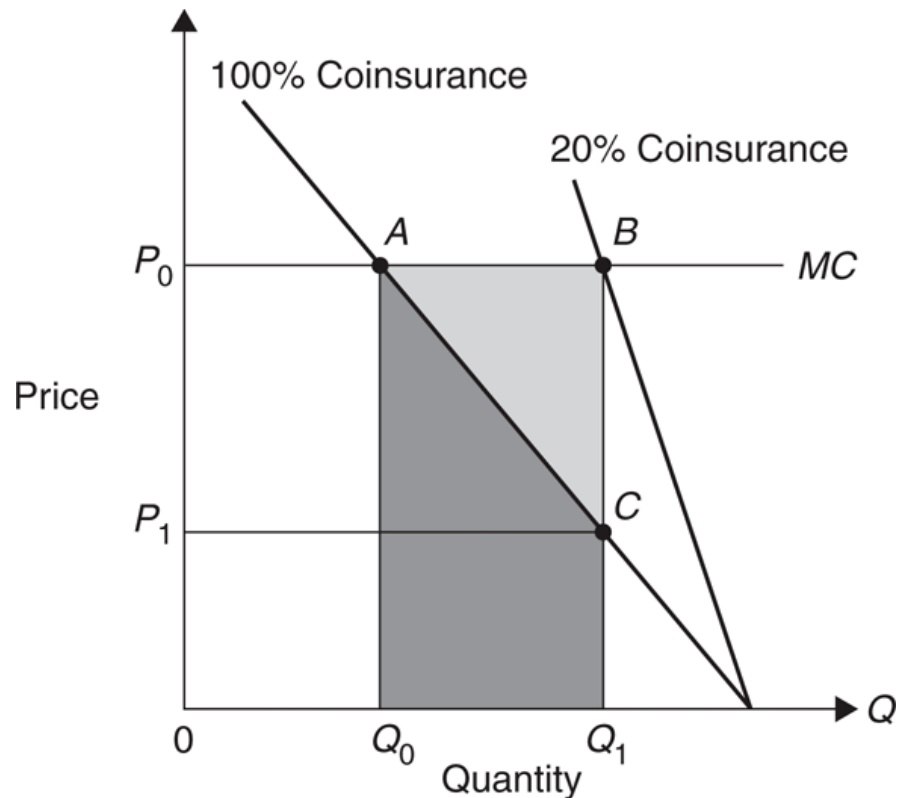
## Efficient Allocation of Resources

- The efficient allocation of society's scarce resources occurs when the incremental cost of bringing the resources to market (marginal cost) equals the valuation in the market to those who buy the resources (marginal benefit).
- If the marginal benefit is greater (less) than the marginal cost, one could improve society's welfare by allocating more (fewer) resources to the sector or individual, and less (more) resources to other sectors.

# No Insurance

- With marginal cost  $P_0$  and no insurance the consumer will demand  $Q_0$  units of care and the consumer's marginal benefit will be equal to the marginal cost.

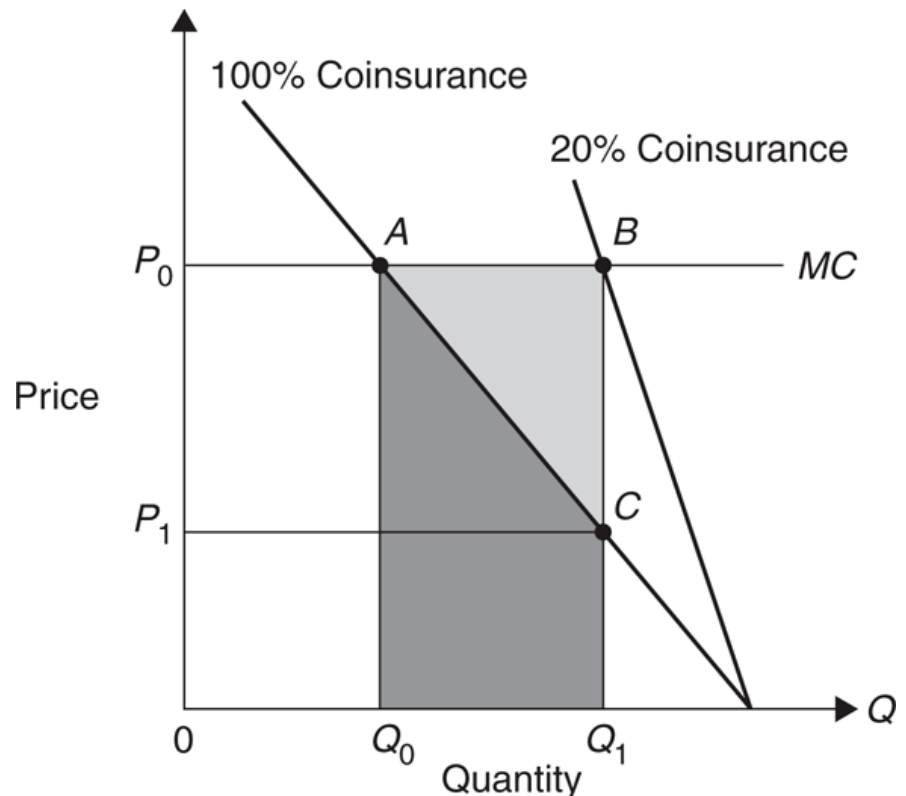
Figure 8-5 Health Care Demand with Insurance



# 20% Coinsurance

- With 20% coinsurance, the price in the market is reduced to  $P_1$  and  $Q_1$  units will be demanded.
- The marginal benefit measured by point C will not fall below the marginal cost measured at B.

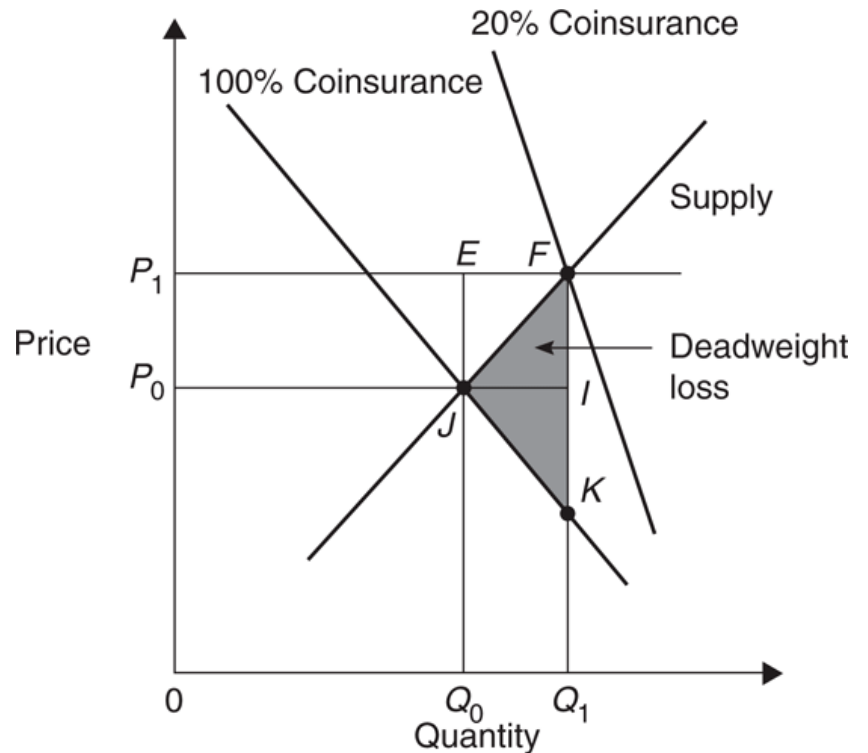
Figure 8-5 Health Care Demand with Insurance



# Deadweight Welfare Loss

- The deadweight loss comes from a misallocation of resources among goods (i.e., more health care is provided than should be, according to consumer preferences). The deadweight loss from the insurance-induced overproduction of health services can be measured as triangle *FKJ*.

Figure 8-7 The Effect of Insurance Cost Sharing with Upward-Sloping Supply



# The Demand for Insurance and the Price of Care

- Martin Feldstein (1973) was among the first to show that the demand for insurance and the moral hazard brought on by insurance may interact to increase health care prices even more than either one alone.
- More generous insurance and the induced demand in the market due to moral hazard lead consumers to purchase more health care.



# The Welfare Loss of Excess Health Insurance

- Insurance policies impose increased costs on society because they lead to increased health services expenditures in several ways:
  - increased quantity of services purchased due to decreases in out-of-pocket costs for services that are already being purchased; increased prices for services that are already being purchased; increased quantities and prices for services that would not be purchased unless they were covered by insurance; or increased quality in the services purchased, including expensive, technology-intensive services that might not be purchased unless covered by insurance.

# Empirical Estimates of Welfare Loss

- Martin Feldstein found that the welfare gains from raising coinsurance rates from .33 to .50 would be \$27.8 billion per year in 1984 dollars.
- Feldman and Dowd (1991) estimate a lower bound for losses of approximately \$33 billion per year (in 1984 dollars) and an upper bound as high as \$109 billion.
- Manning and Marquis (1996) sought to calculate the coinsurance rate that balances the marginal gain from increased protection against risk against the marginal loss from increased moral hazard, and find a coinsurance rate of about 45 percent to be optimal.

# Policy Implications of Welfare Analysis

- The preceding analysis suggests that insurance imposes welfare costs on society because of a misallocation of resources.
  - Increase in quantity of healthcare services that are purchased because of insurance lowering the cost at point of purchase (without insurance these extra units would not be consumed).
- One implication then becomes why should society bother with health insurance?

- There are other reasons to provide insurance for healthcare
  - Income redistribution, government provided healthcare is paid for with tax revenues, those who have higher incomes pay more taxes that can be used to fund healthcare for people who would not otherwise be able to afford it
  - Protects population from losses (efficiency)
  - Equity (everyone is treated the same and has the same opportunity to obtain healthcare)