DEMAND AND SUPPLY OF HEALTH INSURANCE

EE 474 Health Economics

Semester 2/2017

Topics

- What Is Insurance?
- Risk and Insurance
- Demand for Insurance
- Supply of Insurance
- Moral Hazard
- Health Insurance and the Efficient Allocation of Resources
- The New Theory of Demand for Health Insurance

Do You Have Any of these Insurances?

- Health insurance
- Car insurance
- House insurance
- Natural disaster insurance

Example of An Insurance

- There are 100 students in the student union.
- Suppose that 1 out of 100 students *randomly* gets sick and incurs health care costs of $5,000.
- Students worried about potential losses due to illness, so the student union decides to collect $50 from each student and put the $5,000 ($50*100) in the bank.
- If a member becomes ill, the fund is used to pay for the treatment.
- Thus, the $50 is paid to avoid the risk or uncertainty of having to pay $5,000 when ill.

Insurance Terminology (1)

- *Premium, Coverage*
  - Ex: Premium = $50 (what the insured pays)
  - Ex: Coverage = $5000 (what insurer pays out)
- *Coinsurance and Copayment*
  - Coinsurance is the *percentage* of loss paid by the insured when the loss occurs.
    - Ex: Suppose the coinsurance rate = 20% and the cost of health care is $1000. So, the insured would have to pay $200.
  - Copayment is the *fixed amount* paid by the insured when the loss occurs.
    - Often times, the copayment is fixed, regardless of the amount of loss.
- *Deductible* : Maximum amount the insured needs to pay out-of-pocket before the insurance policy starts.
  - Ex: The deductible is $400.
    - If total loss = $350, the insured pays the total amount.
    - If total loss = $500, the insured pays$400 and the insurer pays $100.

Insurance Terminology (2)

- *Exclusions* : Services or conditions not covered by the insurance policy
  - Ex: Cosmetic or experimental treatments.
- *Limitations*: Maximum coverage provided by insurance policies.
  - Ex: 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.
  - Ex: pregnancy, cancer, HIV/AIDS, chronic diseases
- *Loading Fees*: General costs associated with the insurance company doing business, such as sales, advertising, or profit.

Insurance vs. Social Insurance

- In this lecture, we will talk about *private* health insurance.
- (Private) Insurance
  - Provided through markets
  - Buyers buy insurance to protect themselves against rare events with certain probabilities
- Social Insurance- Government is the insurer:
  - Premiums are heavily and often completely subsidized.
  - Participation is constrained according to some eligibility rules.

Risk and Insurance: Expected Value

- Expected value is determined by summing the values of the various outcomes of an event times the probabilities that each outcome will occur.
- Example: the expected value (or expected return) of a coin toss game where you win $1 if heads appears and $0 if tails appears is:

$$EV = Prob_{heads} * \$1 + Prob_{tails} * \$0$$

$$= 0.5 * \$1 + 0.5 * \$0 \quad \text{(assuming a fair coin)}$$

$$= \$0.5$$

Expected Value (In General)

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

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

  - p_i is the probability of outcome *i*, (i= 1, 2, .., n)
  - R_i is the return if outcome *i* occurs.
  - The sum of the probabilities p_i equals 1.
- St.Petersburg's paradox: How much would you pay to play coin toss game where you win $1 if H, $2 if TH, $4 if TTH, $8 if TTTH, etc. (prize = 2^n)?

➔EV = (1/2)*$1 + (1/4)*$2 + (1/8)*$4 + (1/16)*$8 +…

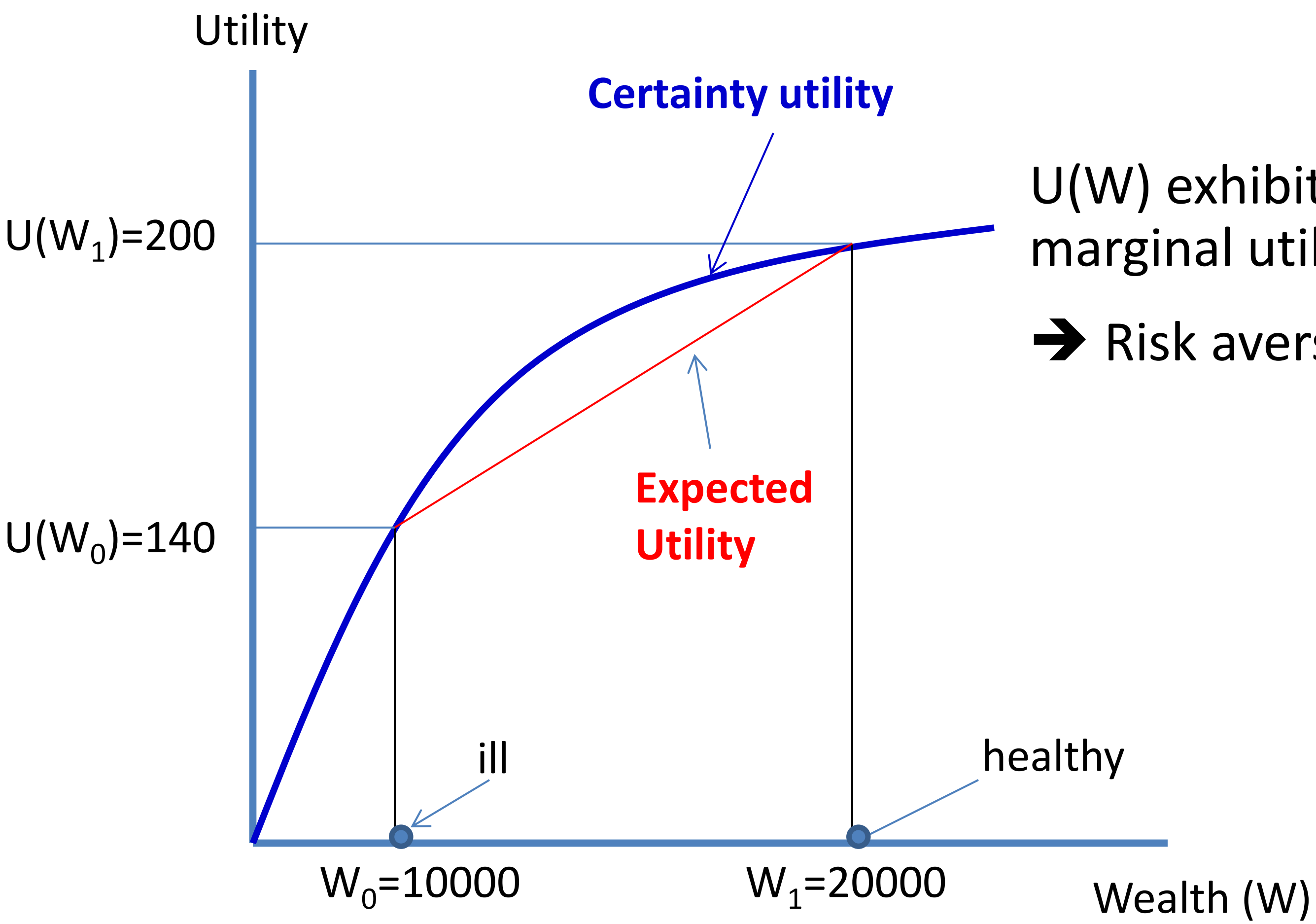
= 0.5 + 0.5 + 0.5 + 0.5 + … = ∞

Marginal Utility of Wealth and Risk Aversion

- Bernoulli's solution was that *money has a different value or utility* depending on *how much you have.*
- From the previous example, if the coin flip yields \$100 or nothing, and you now asked to pay \$50 to play. Would you still want to play?
  - Perhaps not, why?
  - The utility of an extra \$ is worth more if you have less money than the utility of an extra \$ is worth when you have more money.

➢ *Diminishing marginal utility*

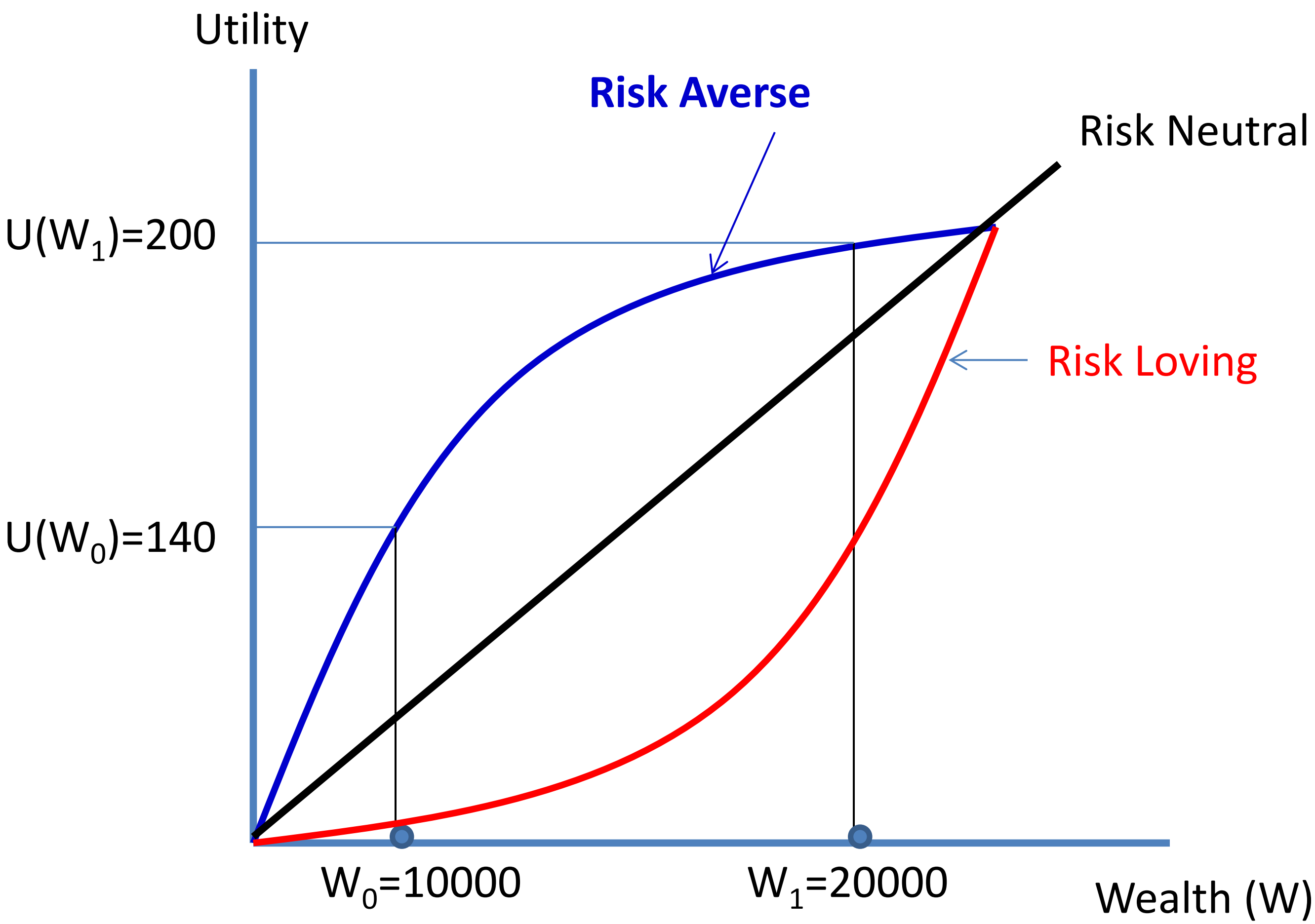
Utility of Wealth



U(W) exhibits diminishing marginal utility.

➔ Risk averse utility

Other Types of Utility



Expected Wealth and Expected Utility if Uninsured

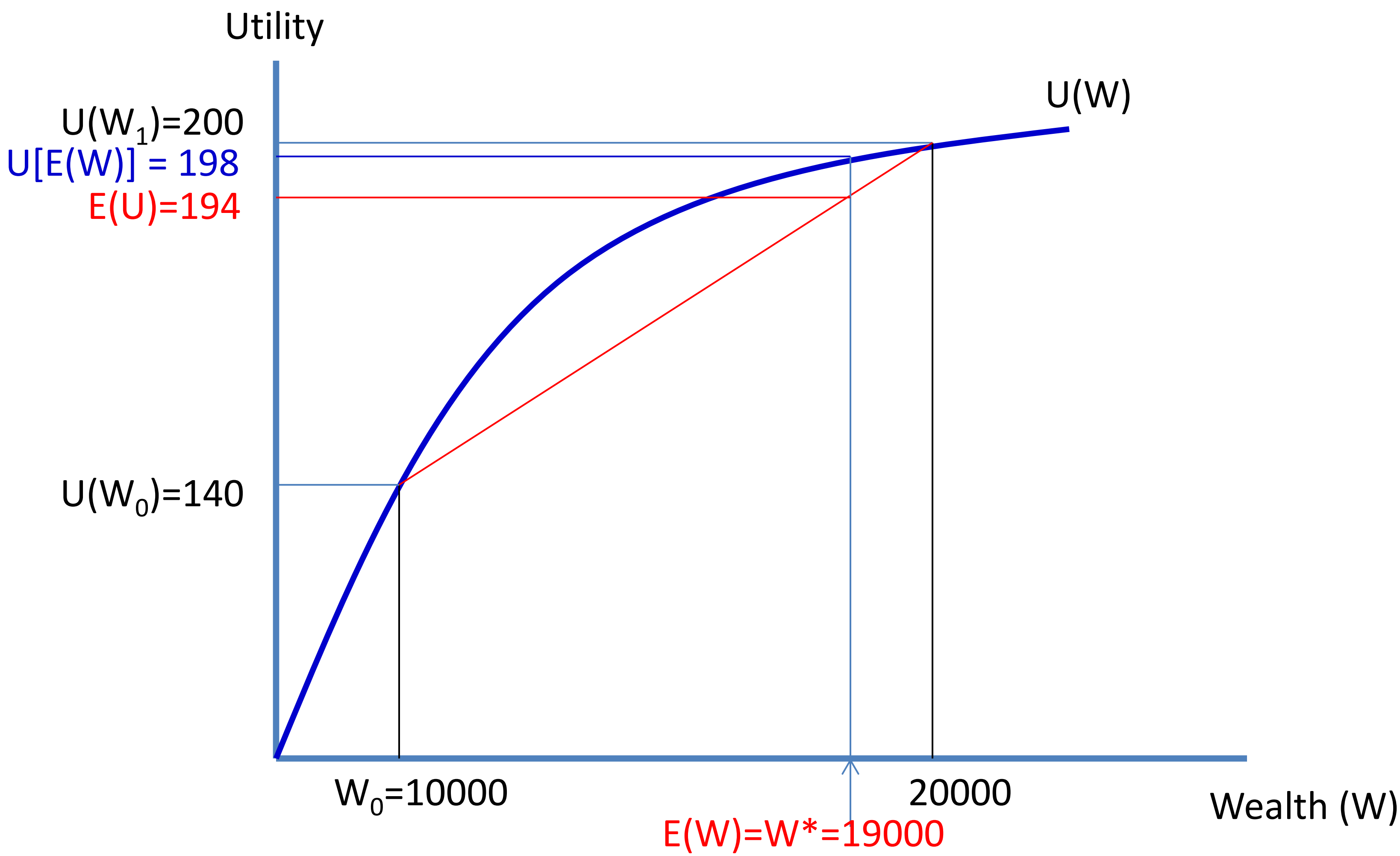
- Suppose the probability of being ill is 0.1 (probability of being healthy = 0.9), and the illness incurs a $10,000 expense.
- **Expected value** of wealth:

$$E(W^{uninsured}) = (Prob_{healthy} * W_{healthy}) + (Prob_{ill} * W_{ill})$$
$$= (0.9*20000) + (0.1*10000)$$
$$= \$19,000$$

- **Expected utility** of wealth:

$$E(U^{uninsured}) = (Prob_{healthy} * U_{healthy}) + (Prob_{ill} * U_{ill})$$
$$= (0.9*200) + (0.1*140)$$
$$= 194$$

Expected Utility if Uninsured



Actuarially Fair Insurance Policy

- An *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 consumer pays the actuarially fair premium (AFP).
- The insurer will pay out ($W_1 – W_0 = 10000$), but that only occurs when the consumer becomes ill (ie. Prob = 0.1)
  - ➢ $AFP = Prob_{ill} * (W_1 – W_0) = 0.1 * (20000 - 10000) = 1000$
  - ➢ The consumer pays $1000 up front, to indicate that he purchased insurance.
  - ➢ AFP changes the consumer's wealth by $W_1 – W^* = W_1 – E(W)$

Expected Utility if Insured

- **Wealth** when *insured*:
  - If healthy: $W_{healthy} = W_1 - (W_1 - W^*) = W^*$
    AFP
    - ➢ $W_{healthy} = 19{,}000$
  - If ill: $W_{ill} = W_1 - (W_1 - W_0) - (W_1 - W^*) + (W_1 - W_0) = W^*$
    Loss due to illness; AFP; Insurance benefits
    - ➢ $W_{ill} = 19{,}000$
- **Expected value of wealth** if insured:

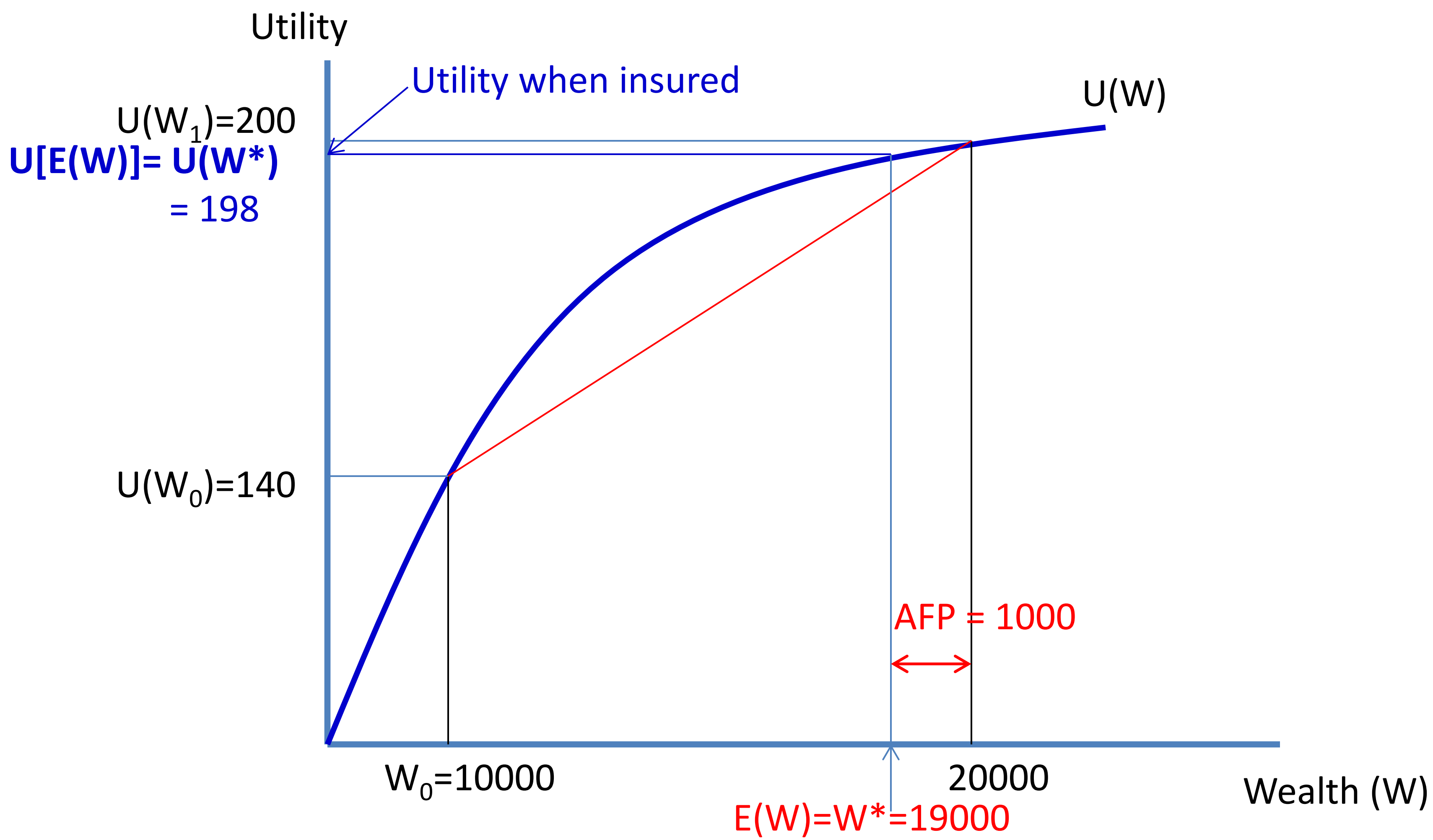
$$E(W^{insured}) = (Prob_{healthy} * W^*) + (Prob_{ill} * W^*) = W^* = 19{,}000$$

- **Expected utility** if insured:

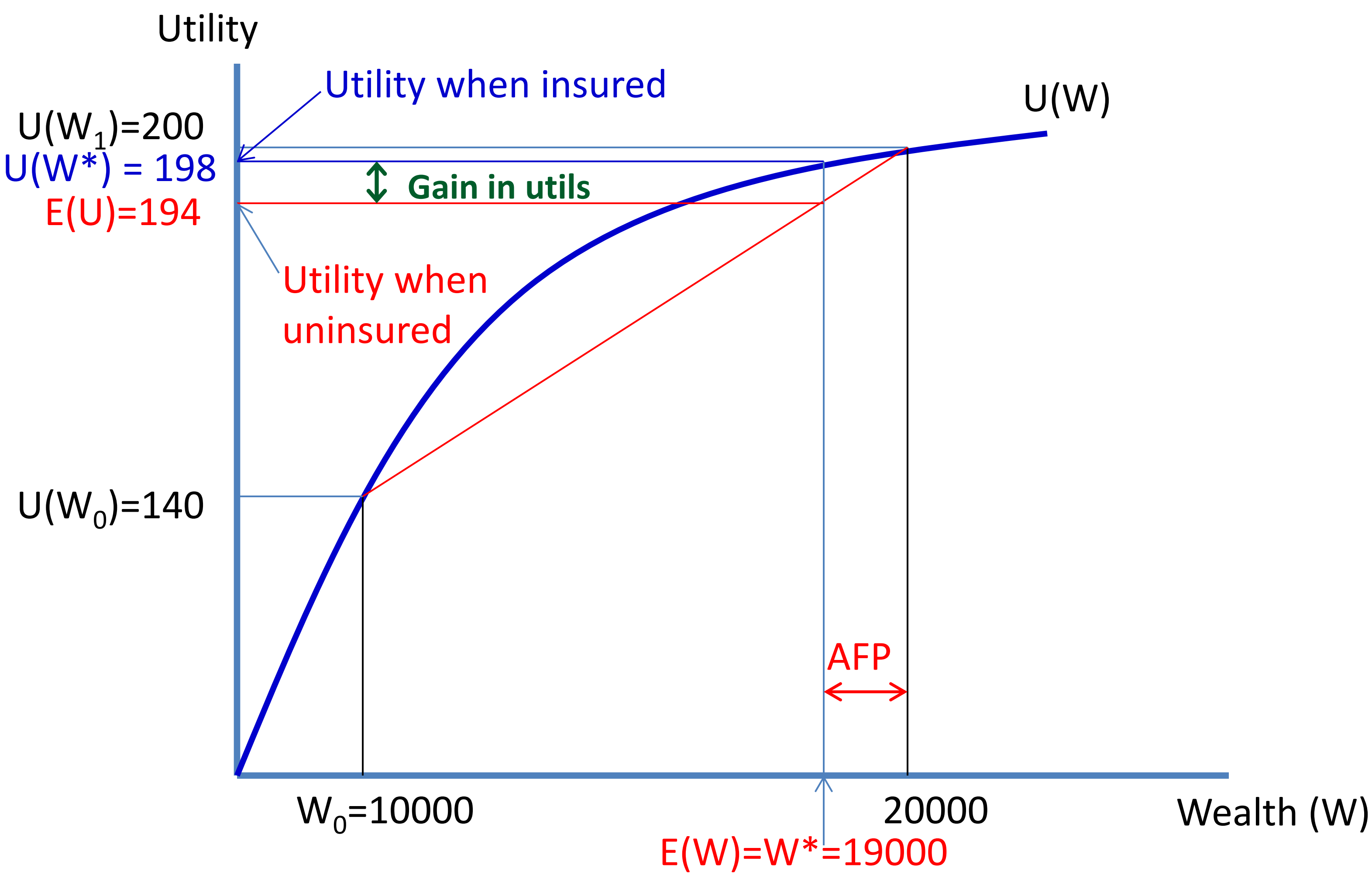
$$E(U^{insured}) = (Prob_{healthy} * U(W^*)) + (Prob_{ill} * U(W^*)) = U(W^*)$$

➢ Expected utility if insured is certain!

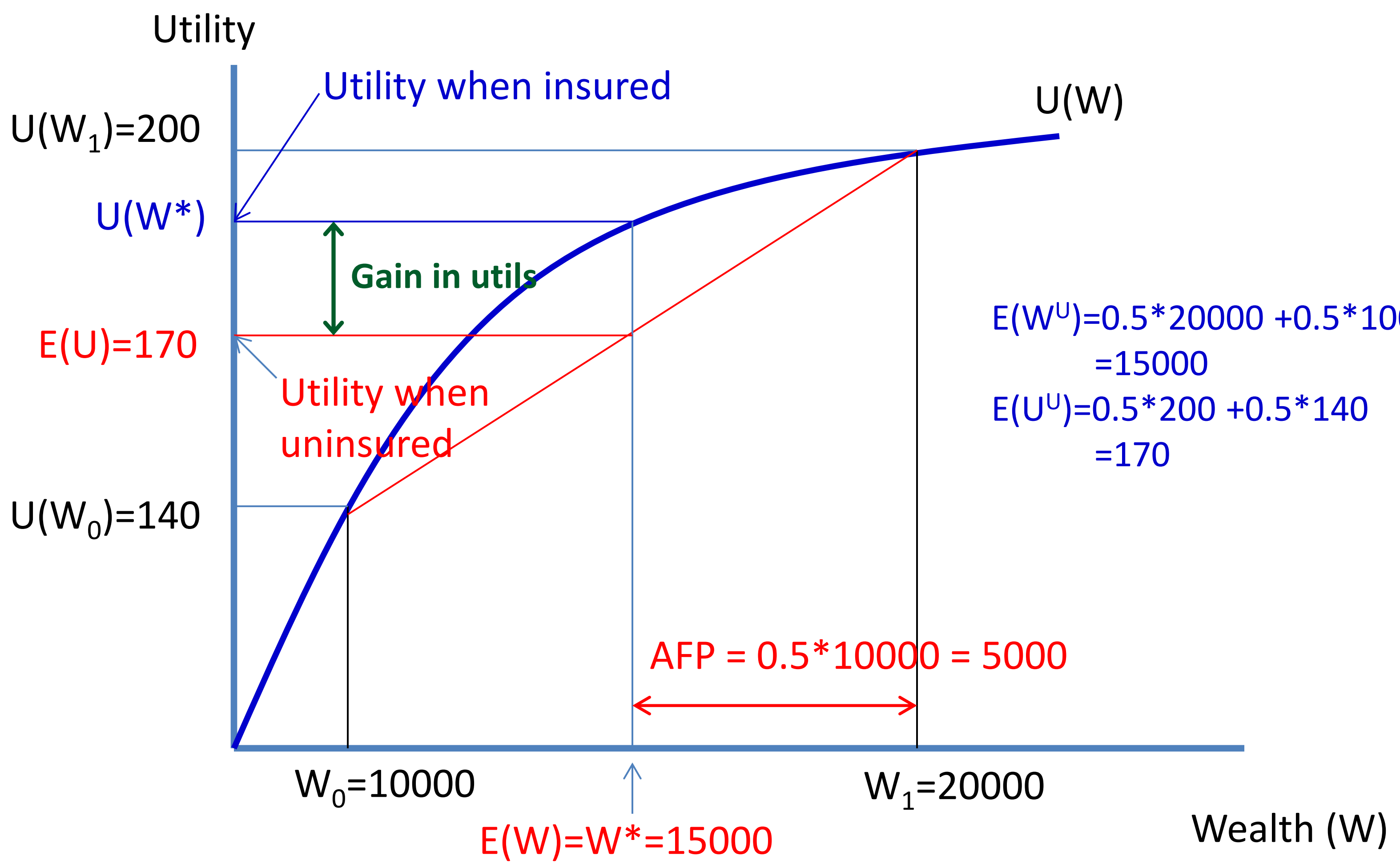
Expected Utility if Insured



Expected Utility if Insured and Uninsured



Expected Utility if Insured and Uninsured (when P_{ill}=0.5)



$E(W^U)$=0.5*20000 +0.5*10000
=15000
$E(U^U)$=0.5*200 +0.5*140
=170

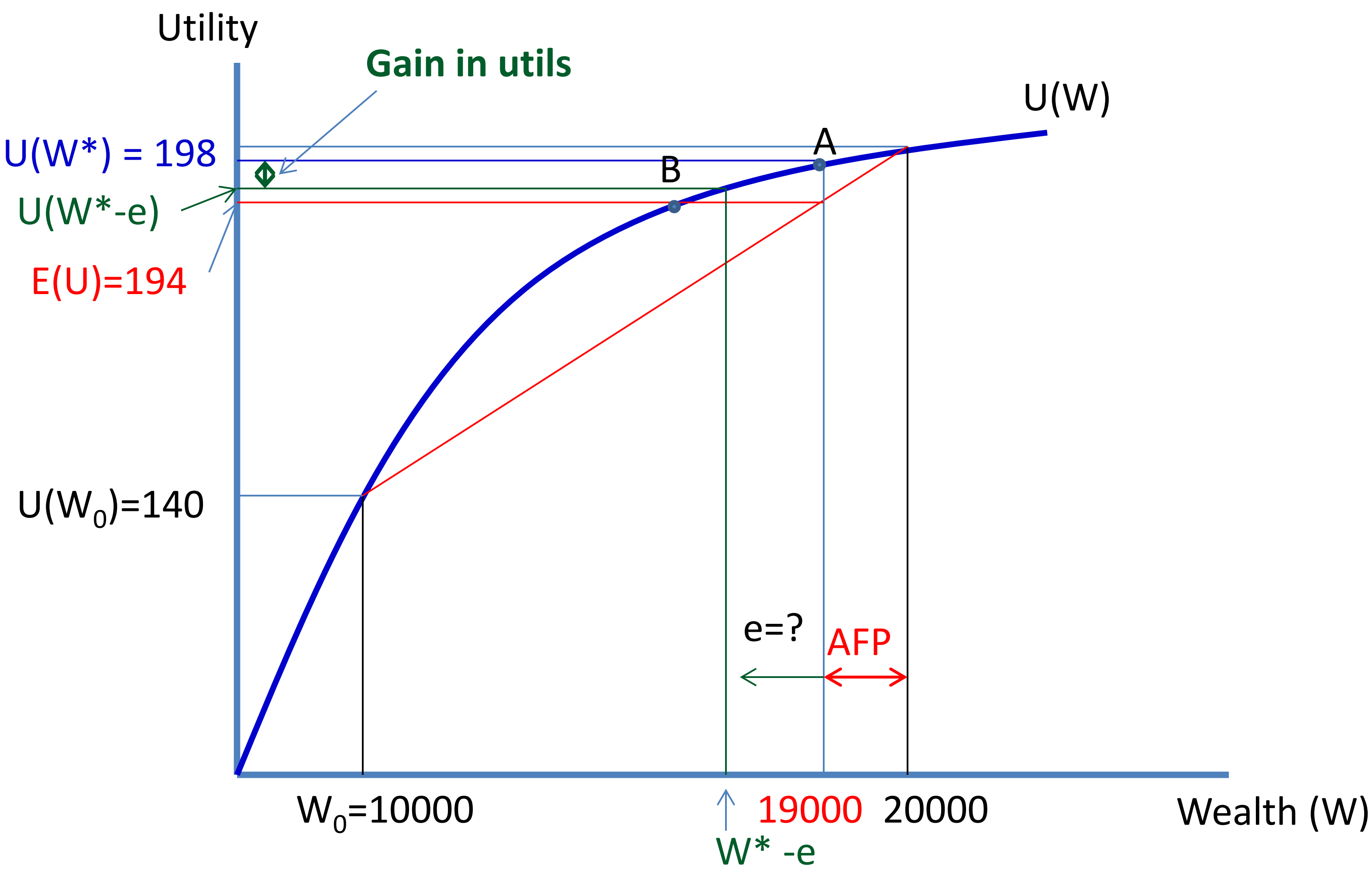
Gain from Insurance in Utility

- If insured, $EU^{ins} = U(W^*)$, and if uninsured, $EU^{unins} = E(U^{unins})$
  - Gain from insurance is $U(W^*) – E(U^{unins})$ in utility terms
  - In our example, gain from insurance = 198 – 194 utils.
- Conventional theory of the demand for health insurance :
  - Insurance is a choice between certainty and uncertainty (Friedman and Savage, JPE, 1948)
  - Consumers buy insurance because they prefer certain loss (the premium) to uncertain loss (medical care expenses if ill) of the same expected magnitude.
  - *Consumers are risk averse.*
- "Preference for certainty" ~ "risk avoidance"

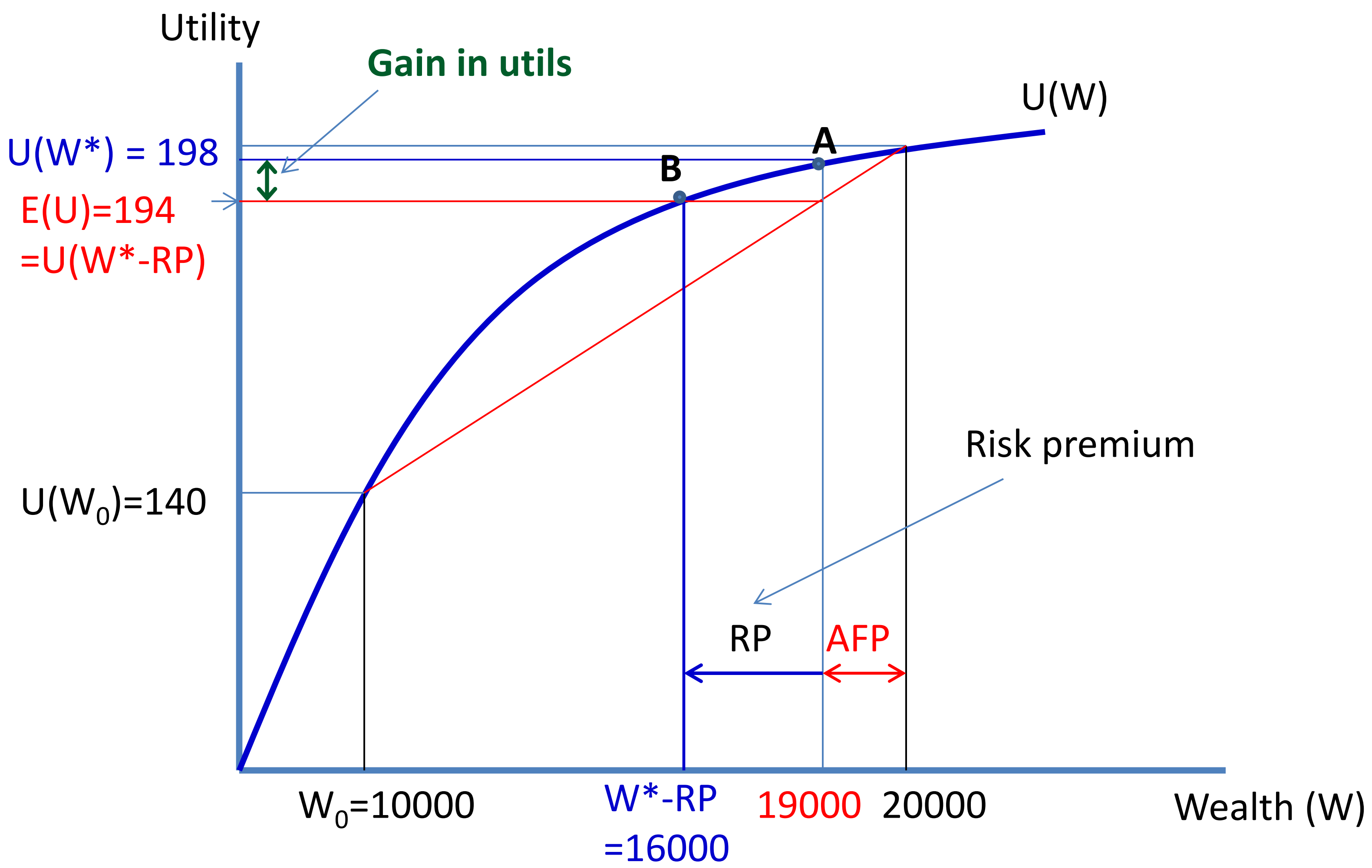
Gain from Insurance in Dollars

- The gain from EU to U(W*) is in utility terms.
- What about the gain in *dollar* terms?
  - We know that AFP is the amount the consumer would expect to pay with or without insurance.
  - What is the maximum amount that the consumer would be willing to pay for insurance (i.e. how much more than the AFP)?
  - The additional amount the consumer would be willing to pay is the value of insurance.

Gain from Insurance in Dollars



Gain from Insurance in Dollars



Value of Insurance

- The risk premium (RP) is the maximum amount over and above the AFP that the consumer would be willing to pay for insurance.
- If the consumer pays AFP + RP for insurance, he would be *indifferent* to being insured or uninsured.
- The *welfare gain* from risk avoidance is measured in dollars by the risk premium and represents the value of the welfare gain from being insured.
  - Example: The consumer would be willing to pay up to $4,000. Thus, the welfare gain is equal to $4000-$1000 = $3000.
  - Note: 4,000= 20,000-16,000, where 16,000 is wealth associated with U(W)=194.

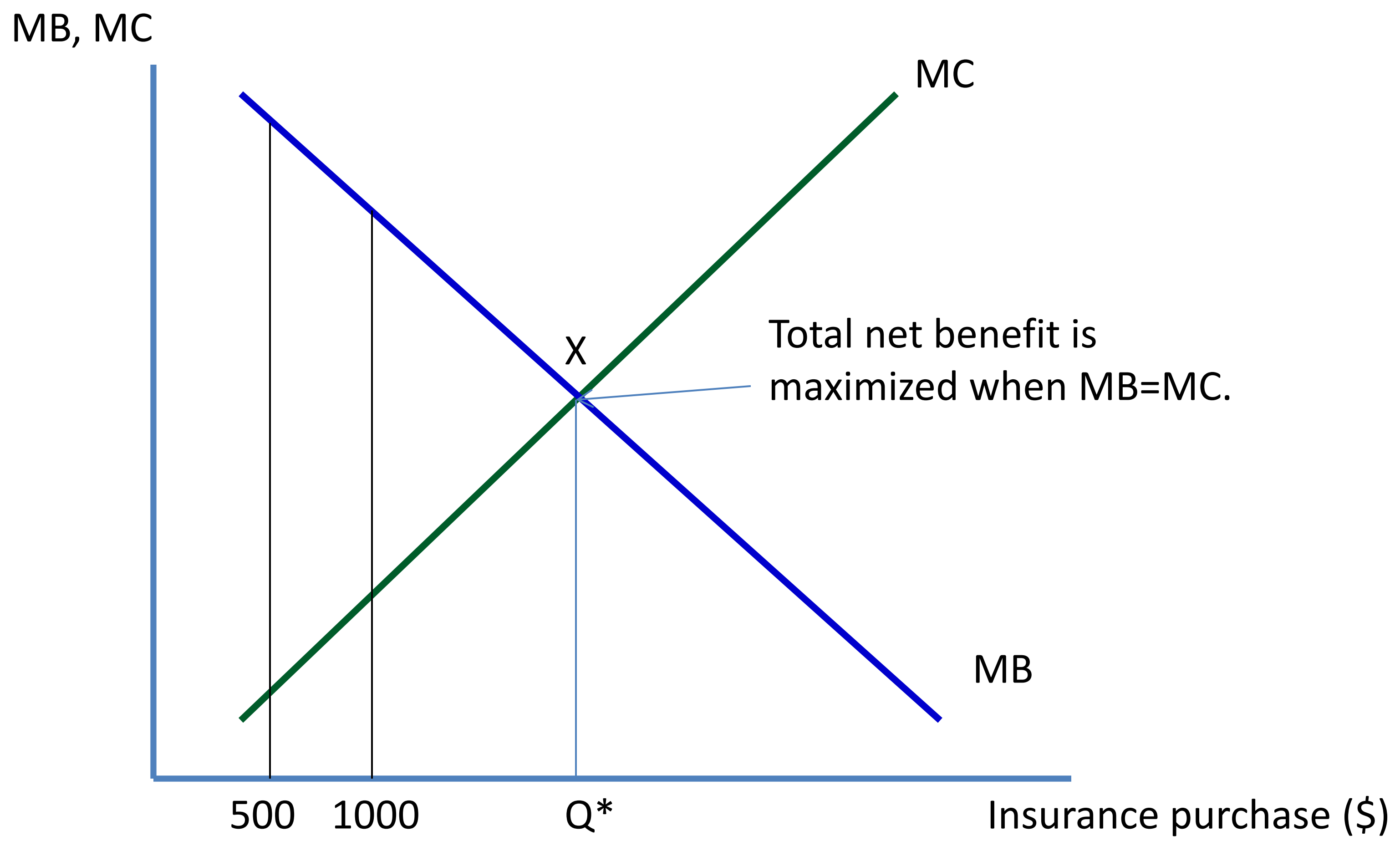
Demand for Insurance

- Apply the concepts of marginal benefits (MB) and marginal costs (MC) to determine health insurance choice.
- Suppose that the insurance coverage = $500, and the consumer must pay a 20% premium (20%*500 = $100).
- New wealth when ill: W_I' = 20,000 –10,000 –100 +500 = 10,400
- New wealth when healthy: W_H' = 20,000-100 = 19,900
  - $MB_{500} = E[MU_{400}]$
  - $MC_{500} = E[MU_{100}]$

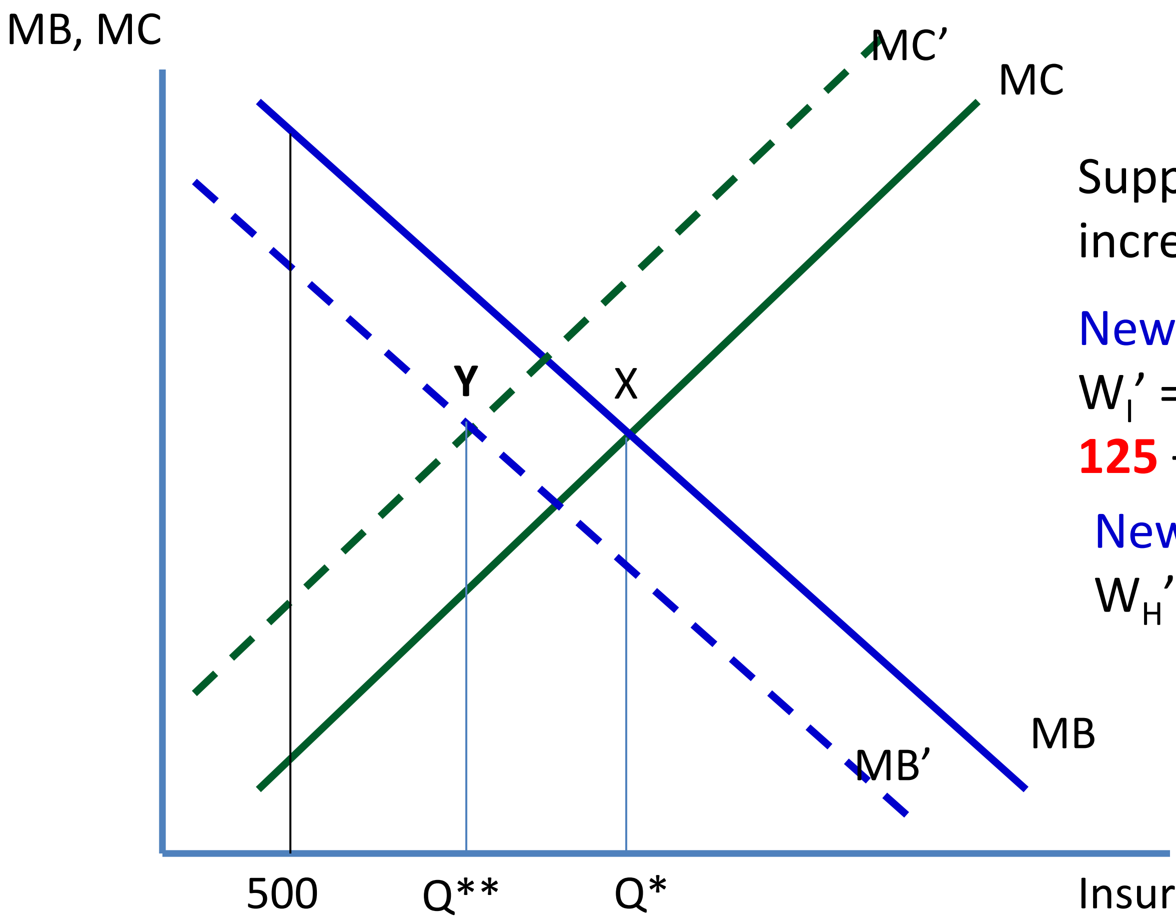
  } $MB_{500} > MC_{500}$
- If purchase an additional $500 insurance, then:
  - $MB_{1000} < MB_{500}$
  - $MC_{1000} > MC_{500}$

  } b/c of diminishing marginal utility of wealth

Optimal Amount of Insurance



Optimal Amount of Insurance: Premium Increases



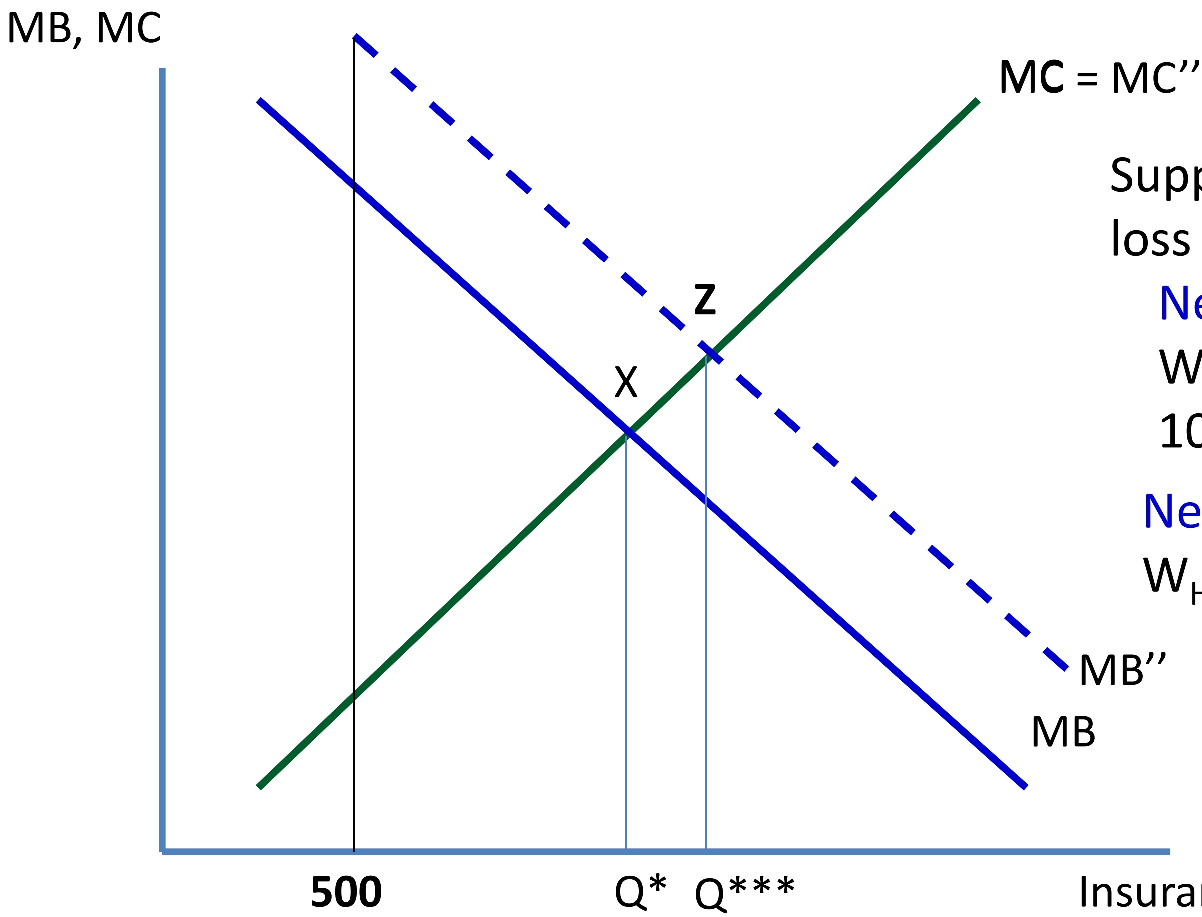
Suppose that premium increases to 25% (=$125)

New wealth when ill:
W_I' = 20,000 –10,000 – **125** +500 = 10,375

New wealth when healthy:
W_H' = 19,875

Optimal Amount of Insurance:

Expected Loss Increases



Suppose that the expected loss increases to $15000.

New wealth when ill:

W_I' = 20,000 –**15,000** – 100+ 500 = 5,400

New wealth when healthy:

W_H' = 19,900

Supply of Insurance

- Insurer's profit: Profit = Total Revenue – Total Cost
- Previous example:
  - Revenues = $100 per policy (20% of $500)
  - Costs:
    - Insurance coverage = $500 (with Prob =0.1)
    - Processing cost (a.k.a. loading fee)= $8
  - For insured who *do not get sick* (Prob = 0.9), the insurer's cost is $8.
  - For insured who *do get sick* (Prob = 0.1), the insurer's cost is $500+ $8 =$508.
- Insurer's profit = $100 – [(0.9*8) + (0.1*508)] = $42 >0

Role of Competition in Insurance Market

- Since there are positive profits ($42), other firms have incentive to enter the market and offer a lower premium (e.g. 15% = $75).
  - Profit = 75 – [(0.9*8) + (0.1*508)] =$17 > 0
- Eventually, the entry into the market would continue until excess profit is driven away, i.e. profit= 0 (perfect competition condition).

- What is the premium rate under perfect competition?
  - Try premium rate = 11.6% !

Competitive Premium

- Let *a* = premium rate, *q* = amount of payout (coverage), *t* = processing cost, and *p*= probability of payout.
  - $Profit = aq - pq - t$
- Under perfect competition: $Profit = aq - pq - t = 0$

  $a = p + (t/q)$ ⟸ "Competitive premium rate"

- When t=0, the premium is the actuarially fair rate

  → $a = p$.

- Example: p = 0.1, t= 8, q=500

  → $a^* = 0.116$

Optimal Level of Coverage

- Suppose *no* loading costs and the insurance market is perfectly competitive.
- To maximize utility, the consumer will chose the coverage level that equates her *expected wealth when healthy* to her *expected wealth when ill*.
- Same example (P_{ill} = 0.1, loss =10,000):
  - $W_{healthy}$ = \$20,000 – *(a*q)*
  - W_{ill} = \$20,000 – \$10,000 – *(a*q) + q*
    - $W_{healthy} = W_{ill}$ → $q^* = 10,000$

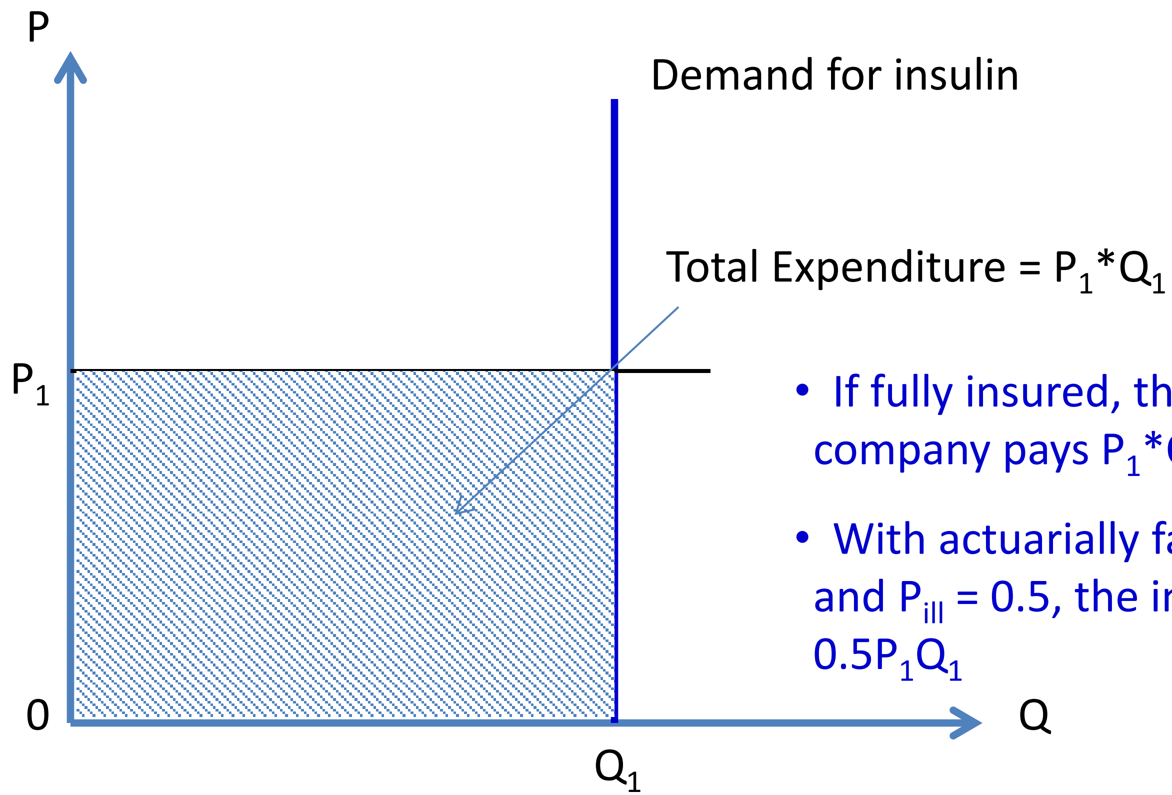
→Optimal coverage is equal to the health care cost (in the absence of loading fees).

→Not necessarily the case!

What is Moral Hazard?

- Moral hazard is the change in behavior that is associated with becoming insured
- *Ex post* moral hazard refers to the change in behavior *after* you become ill
  - An increase in health care consumption by the insured consumers
- *Ex ante* moral hazard refers to the change in behavior *before* you become ill
  - An increase in the probability of illness of the insured consumers because they have fewer incentives to take care of themselves.

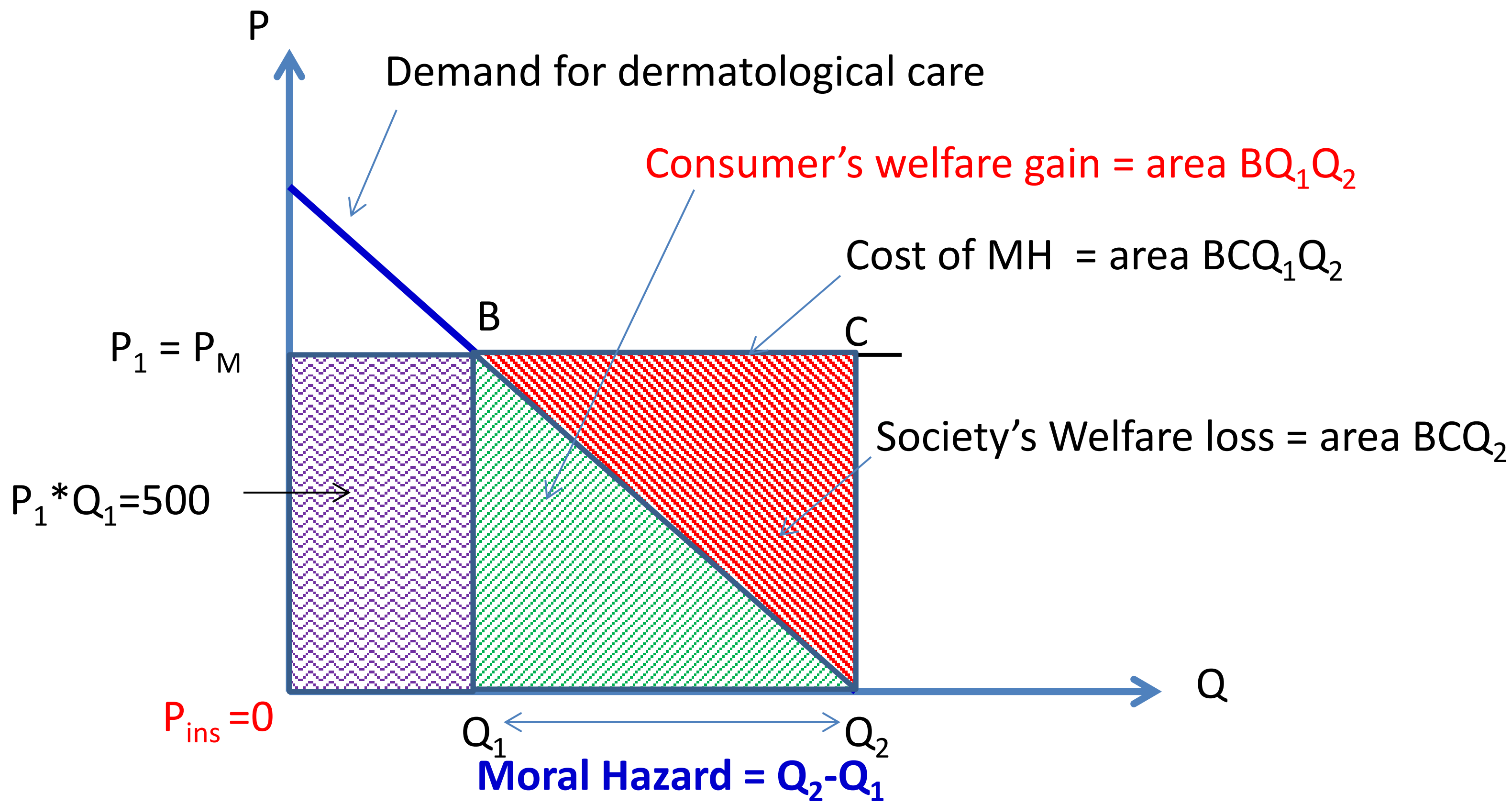
Demand for Care and Moral Hazard (Perfectly Inelastic Demand)



- If fully insured, the insurance company pays $P_1 * Q_1$.
- With actuarially fair insurance and $P_{ill} = 0.5$, the insured pays = $0.5P_1Q_1$

➔ No welfare loss!

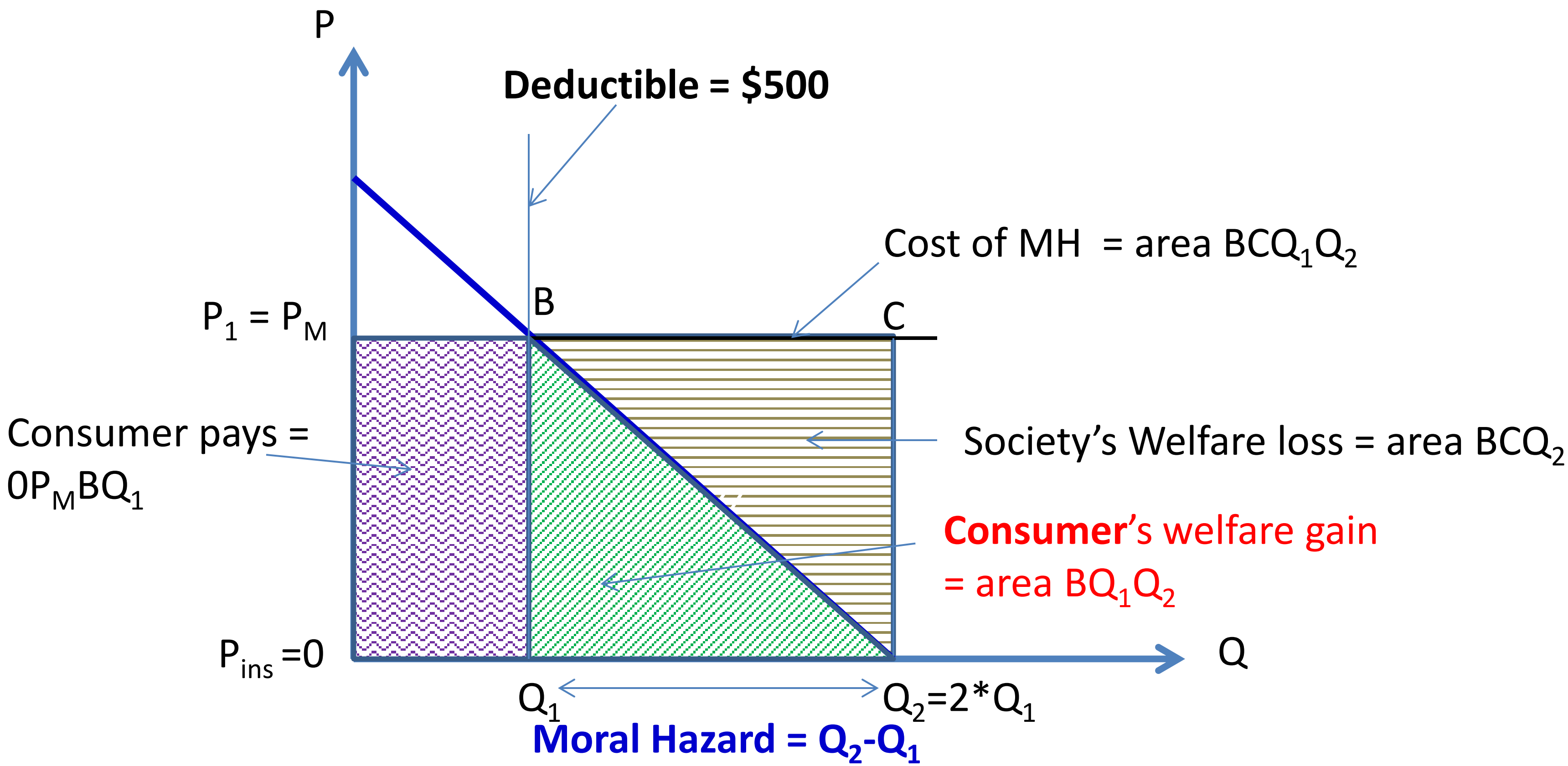
Demand for Care and Moral Hazard
(Relatively Elastic Demand & Full insurance)



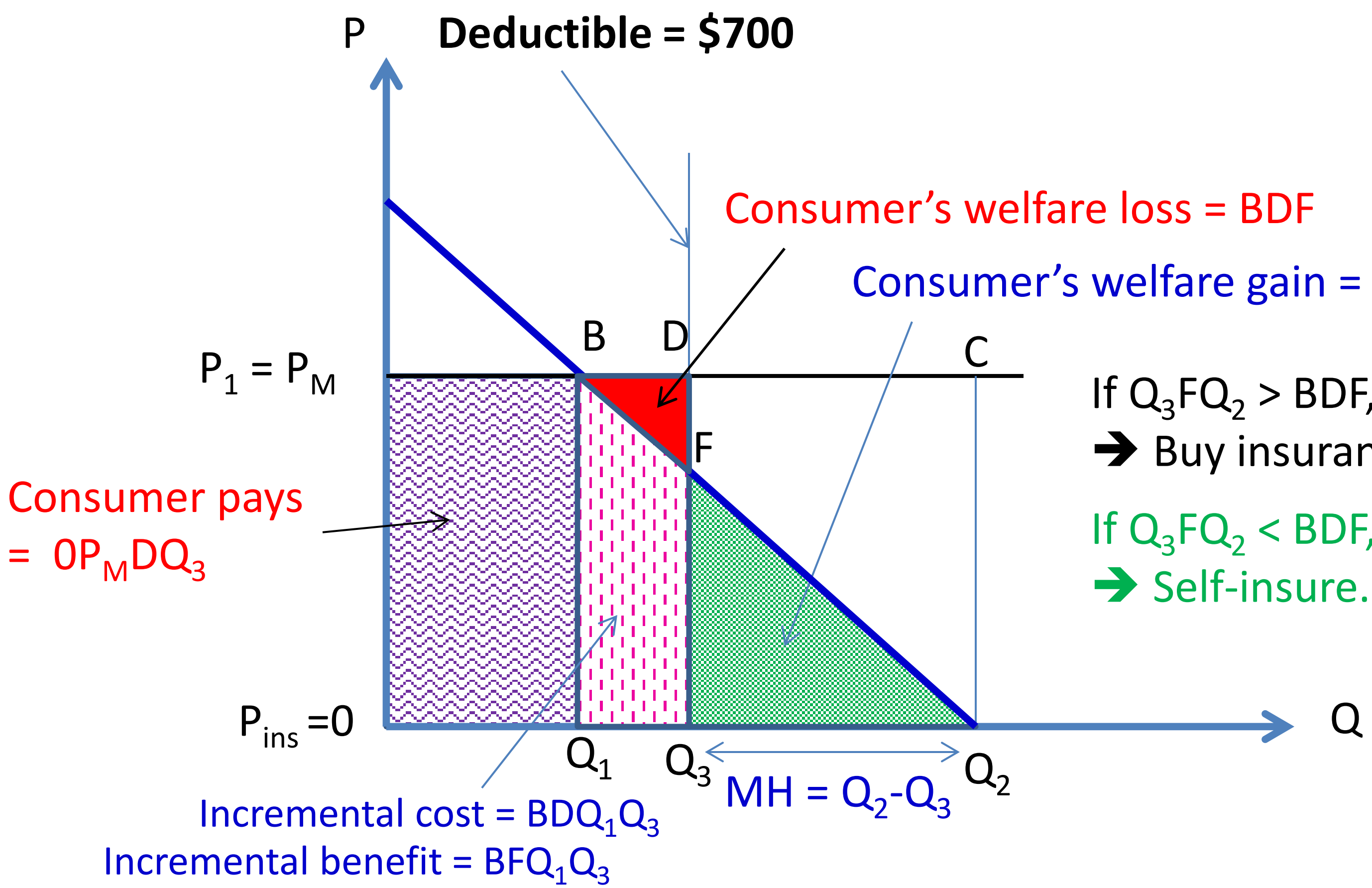
Predictions on the Types of Health Insurance

- More inelastic demand health care services
  - ➢More complete coverage
- More elastic demand health care services
  - ➢Less complete coverage or no insurance
- To reduce moral hazard, insurance companies use the following policies:
  - Deductibles
  - Coinsurance

Demand for Care and Moral Hazard (Elastic Demand & Deductible)



Demand for Care and Moral Hazard (Elastic Demand & Deductible)



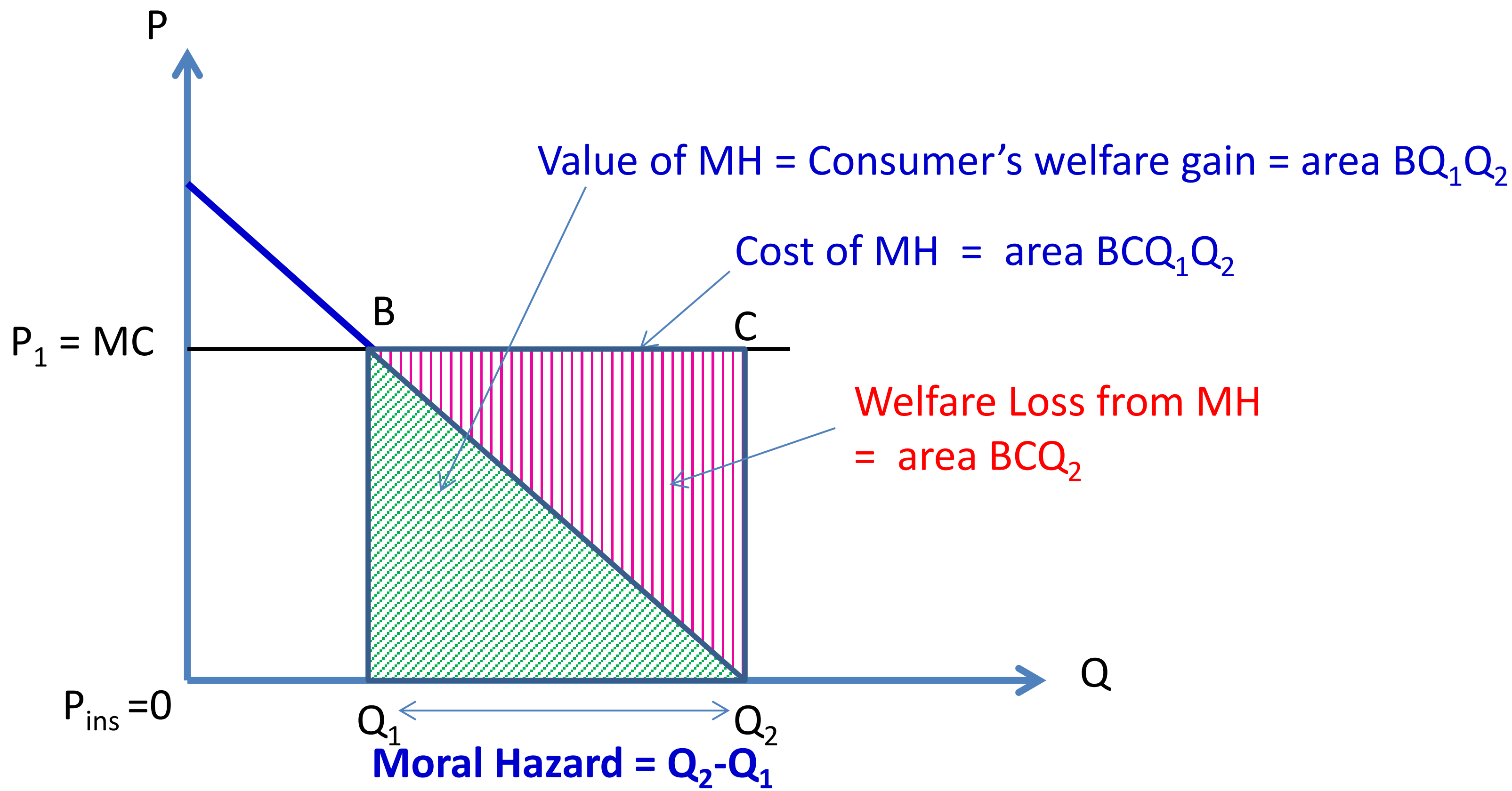
If Q_3FQ_2 > BDF, net welfare gain >0.
➔ Buy insurance.

If Q_3FQ_2 < BDF, net welfare gain <0.
➔ Self-insure.

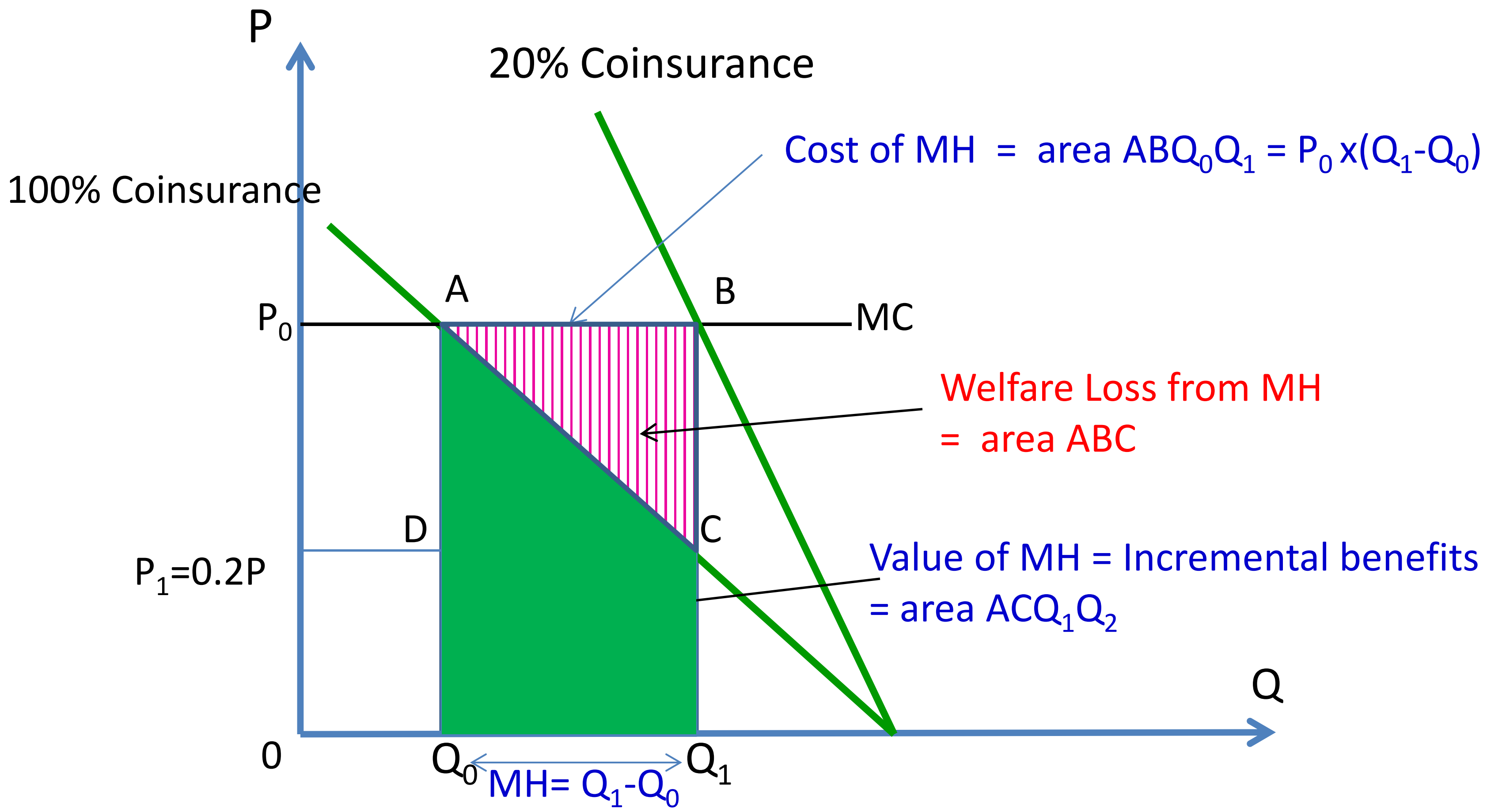
Efficient Allocation of Resources

- The efficient allocation of society's scarce resources occurs when marginal cost (MC) equals marginal benefits (MB).
  - MC = The incremental cost of bringing the resources to market
  - MB = The valuation to those who buy the resources
- If MB ≠ MC, society's welfare could be improved by re-allocating resources.
  - If MB > MC, allocate *more* resource to the individual or sector and *less* resources to others.
  - If MB < MC, allocate *less* resource to the individual or sector *more* resources to others.
- Moral hazard induced by health insurance can lead to inefficient allocation of resources.
  - MC > MB ➔ Welfare loss to society

Moral Hazard and Welfare Loss (Full Insurance)

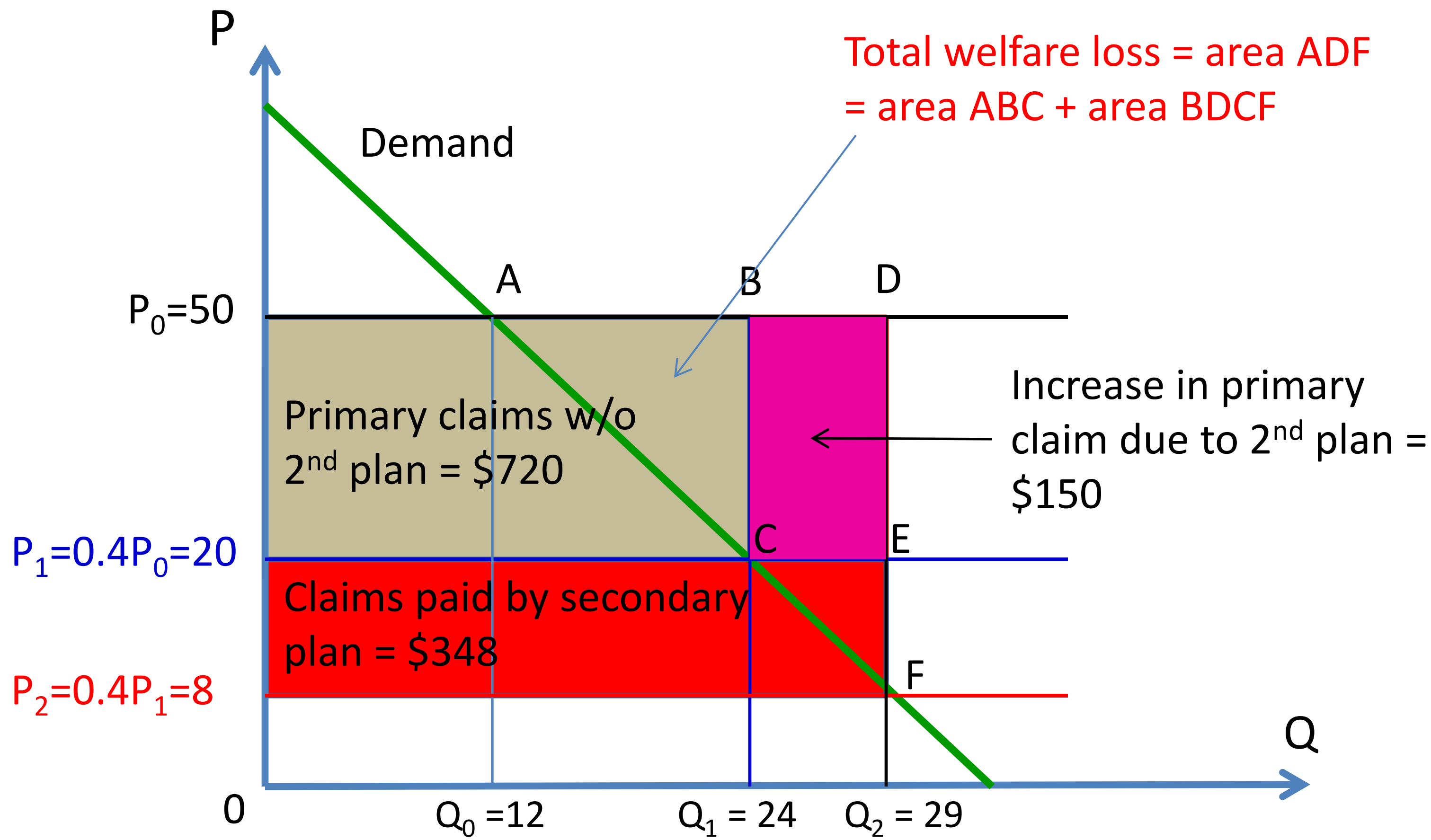


Moral Hazard and Welfare Loss
(20% Co-insurance)

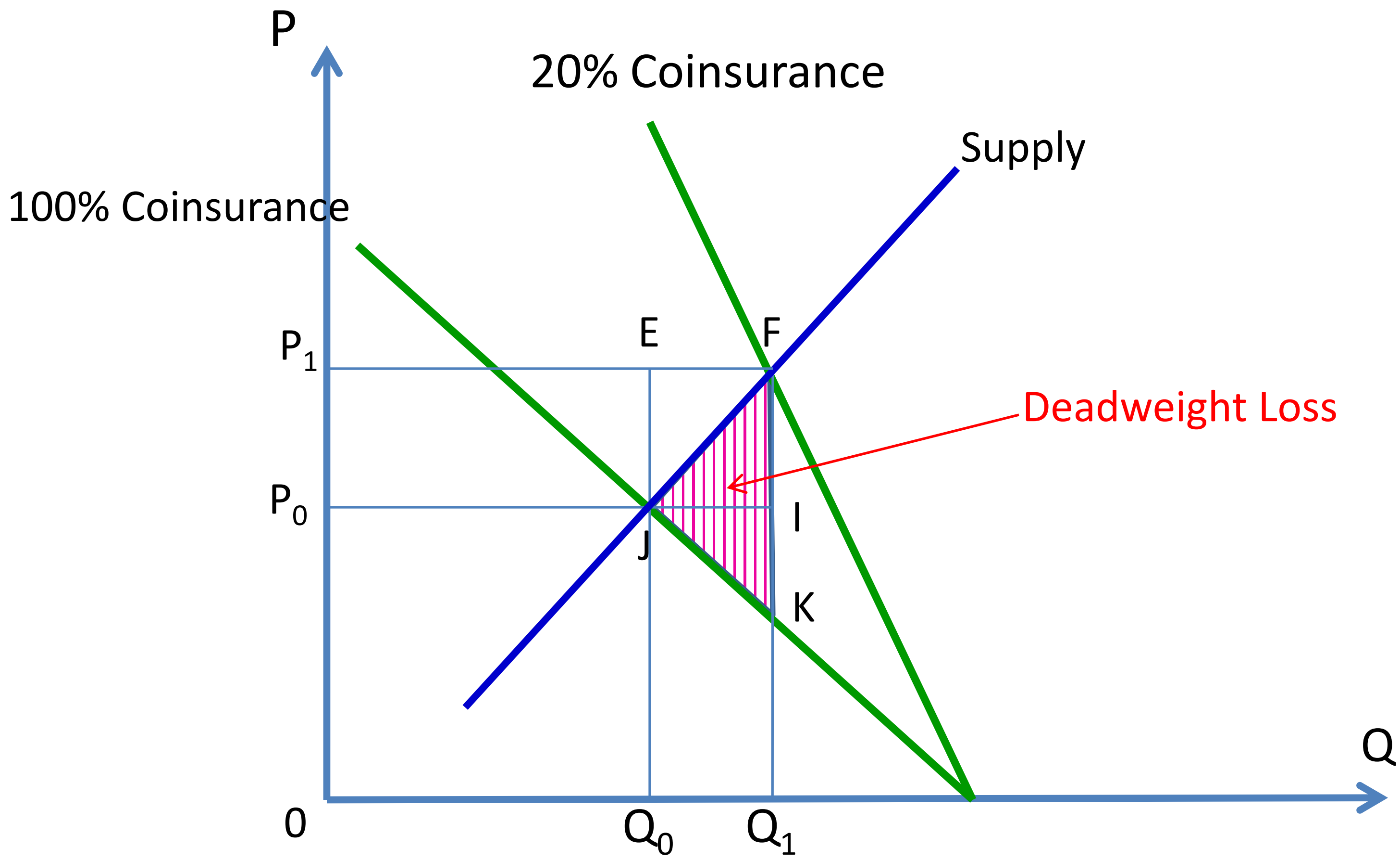


Two-tiers Insurance

(Primary Plan – 60% of total cost & Secondary plan– 60% of the rest)



Deadweight Welfare Loss



The (New) Theory of Demand for Health Insurance

- So far, we have learned about the *conventional insurance theory,* which suggests that health insurance always creates a welfare loss.
- John Nyman's (1999) new theory of demand for health insurance:
  - Health insurance is demanded in order to obtain a transfer of income when ill (income transfers from those who remain healthy to those who become ill).
  - Health insurance generally increases welfare, mainly because of moral hazard which represents access to health care that would otherwise be unaffordable.

Nyman's Model

- Some notations:
  - m_i is total medical care cost when illness occurs
  - r is the premium
  - π is the probability of illness.
  - c = coinsurance rate (Note: we've assumed c=0 previously.)
- Insurer sets a premium, r, at the actuarially fair level:

$$r = \pi(1-c)m_i$$

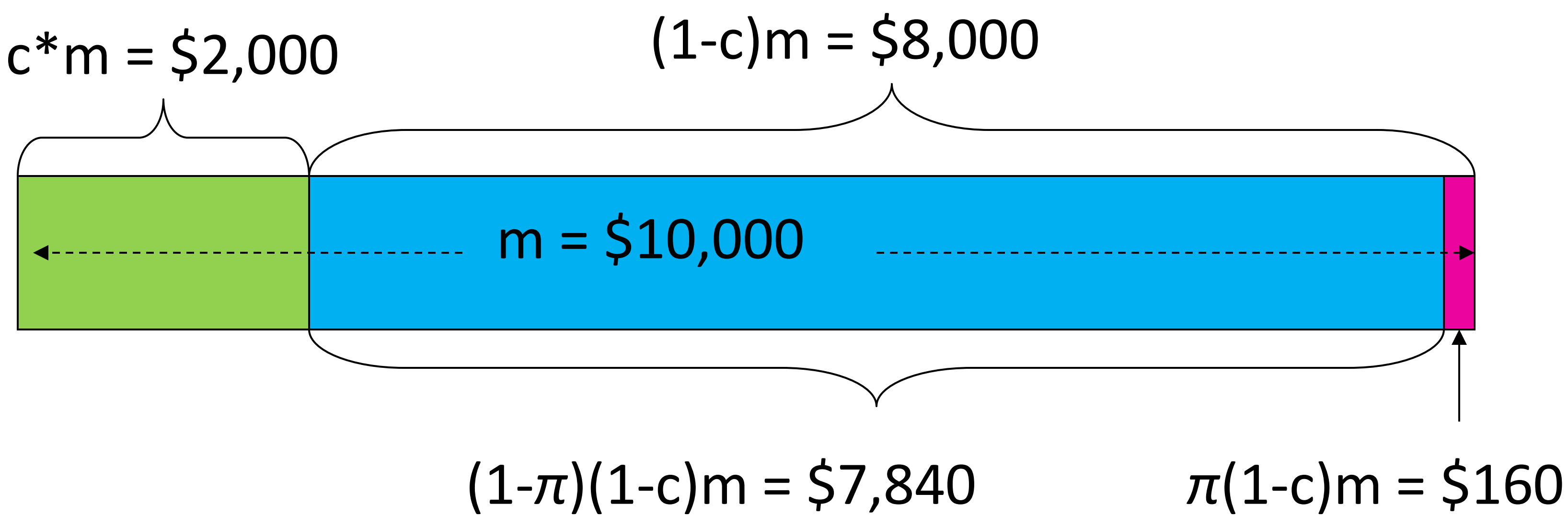
- The payoff that the insurer pays to the beneficiary who becomes ill is equal to $(1-c)m_i$.

Nyman's Model

- Income transfers are the portion of the payoff to the ill that is paid for by those who purchase insurance and remain healthy:
  - *Payoff* to ill: $(1-c)m_i$
  - *Premium* paid by each insured: $\pi(1-c)m_i$
  - *Income transfers* to ill: $(1-\pi)(1-c)m_i$
- Example: Medical spending with insurance is $10,000, coinsurance rate is 20%, and probability of illness is 0.02.
  - Each insured pays: $c{*}m_i$ = $2,000 *out of pocket (i.e. coinsurance)*
  - Insurer pays: $(1-c)m_i$ = $8,000
  - AFP: $r = \pi(1-c)m_i$ = 0.02($8,000) = $160
  - Income transfers are: $(1-\pi)(1-c)m_i$ = 0.98($8,000) = $7,840

Diagram of c, π, and m in Nyman's Model

- Example
  - m = $10,000
  - c=20%
  - π=2%



Elizabeth Example

- Elizabeth is diagnosed with breast cancer.
- *Without insurance,* she purchases
  - Mastectomy for $20,000 ⇐ Spending without insurance
- *With insurance* that pays for all her care, she receives the
  - Mastectomy for $20,000,
  - A breast reconstruction for $20,000
  - 2 extra days in the hospital for $4,000

  } Spending with insurance = $44,000
- Moral hazard spending:
  - $44,000 – $20,000 = $24,000 for breast reconstruction and hospital days

Elizabeth Example

- Question: Is the $44,000 spending efficient?
- Assume that, if she had been paid off with a lump sum payment equal to the amount the insurer paid for her care ($44,000), she would have purchased the mastectomy and the breast reconstruction, but not the 2 extra days in the hospital.
- Conclusion:
  - The breast reconstruction is *efficient* and welfare increasing because Elizabeth would have purchased that with the income transfer.
  - The 2 extra days in the hospital are *inefficient* and welfare decreasing because she only purchases them because the insurer had distorted the price.

Illustration of Elizabeth's Welfare Gain