PRODUCTION OF HEALTH

EE 474 Health Economics

Semester 2/2019

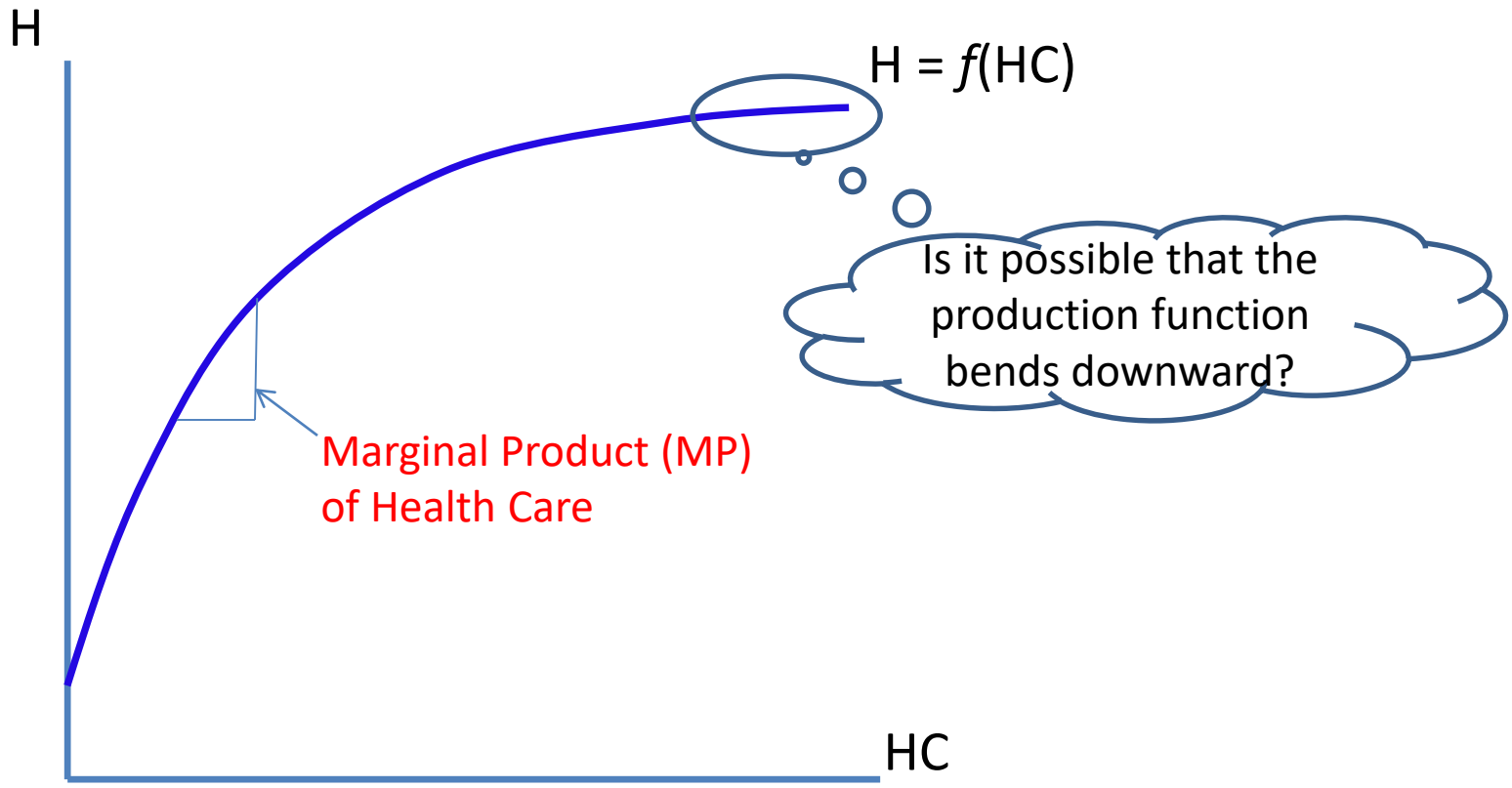
Topics

- Production function of health
- Health as a function of health care
  - Technical efficiency
  - Allocative efficiency
  - Some empirical evidence
- Fuchs' (1974): *Who Shall Live?*
- Other inputs in the health production

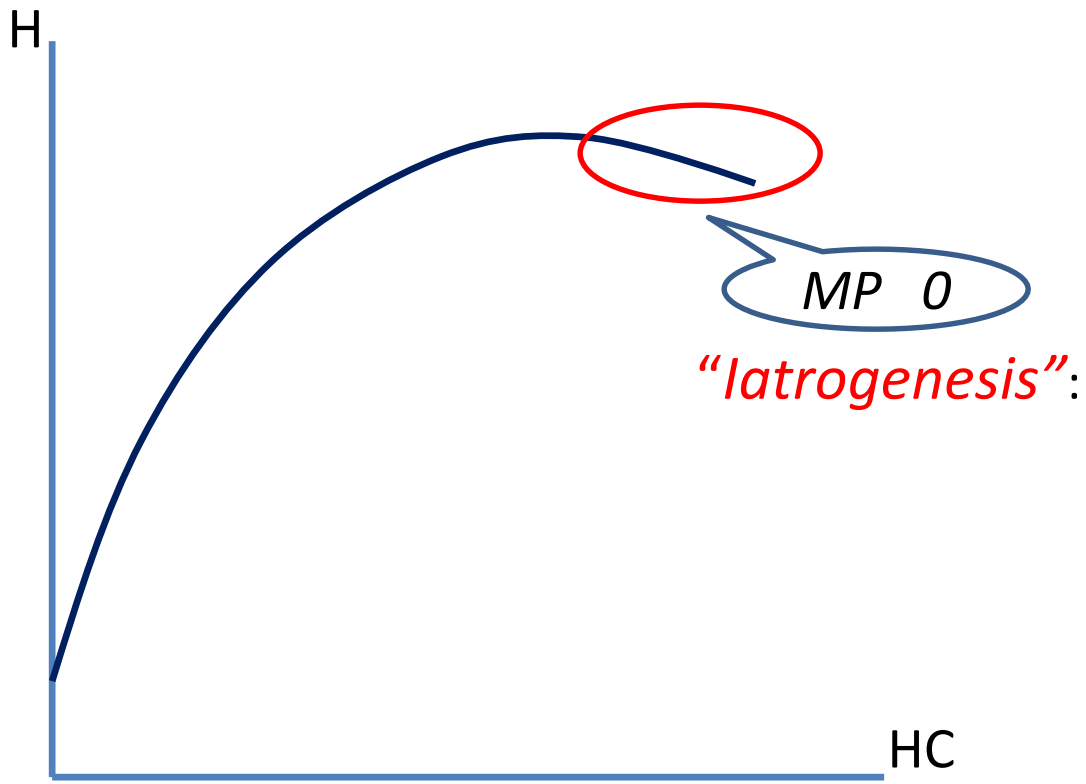
Production of *Health*

- Last time, the output of production was *health care*.
- In this lecture, *health* (or *health status*) is an *output*.
- What are possible inputs in the health production?
  - H = H(???)
  - H = H(**health care**, disease, nutrition, lifestyles, environment, public health, …)
- In this context, *health care is an input* in the production of health.

Production Function of Health

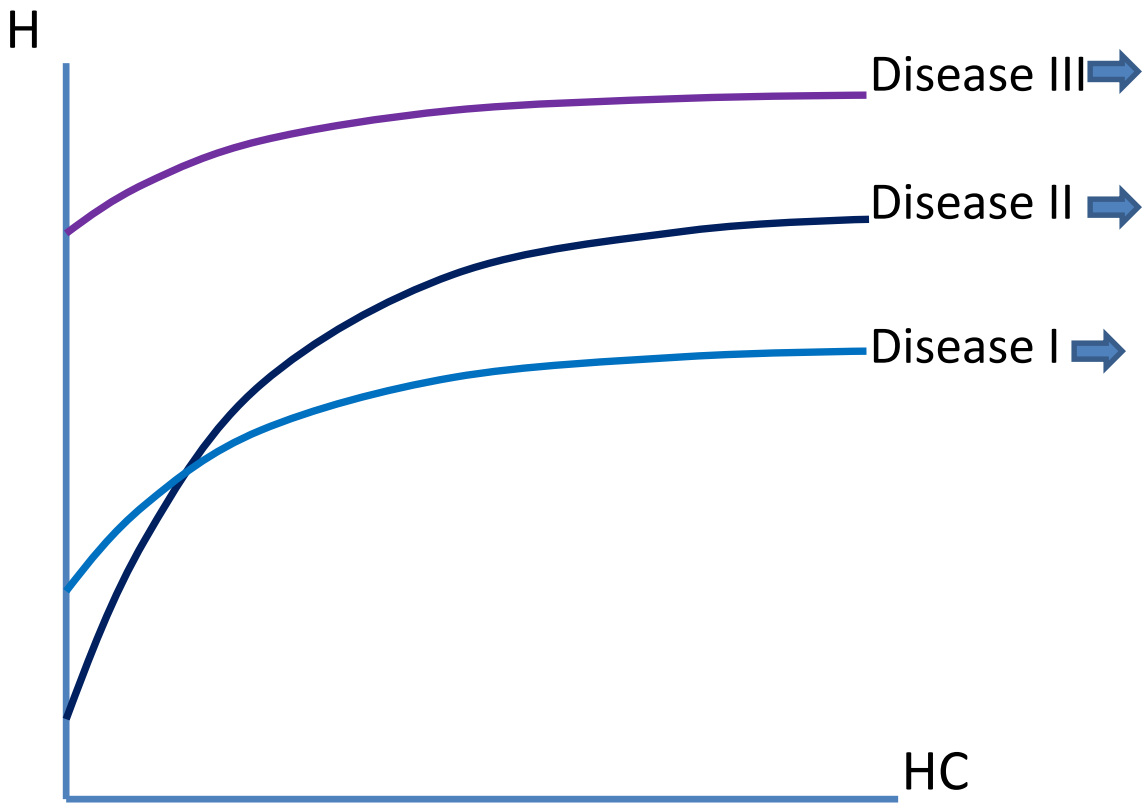


Production Function of Health When $MP_{HC} < 0$



"Iatrogenesis":

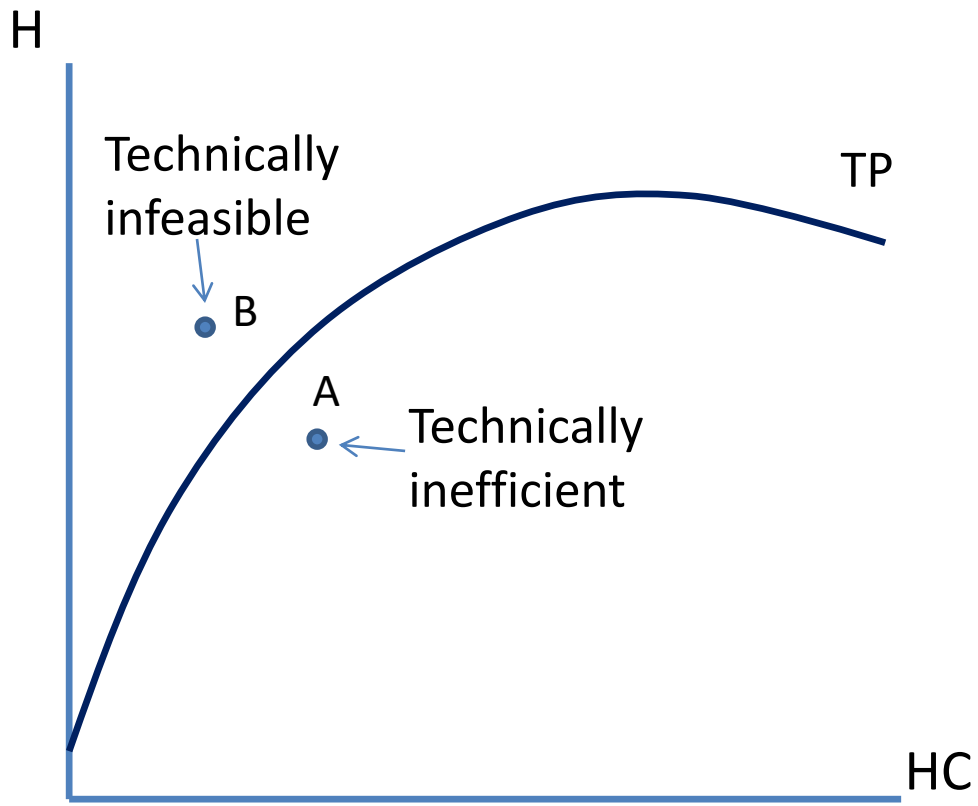
Production Function of Health for Different Diseases



Technical Efficiency

- Technical efficiency :
  - Produce the maximum amount of output from a given amount of inputs –
- The production function shows the maximum that can be produced by any set of inputs.
- So, the production function of health includes only *technically efficient* input-output combinations.

Production Function (1 Input)



Technical Efficiency (2 inputs)

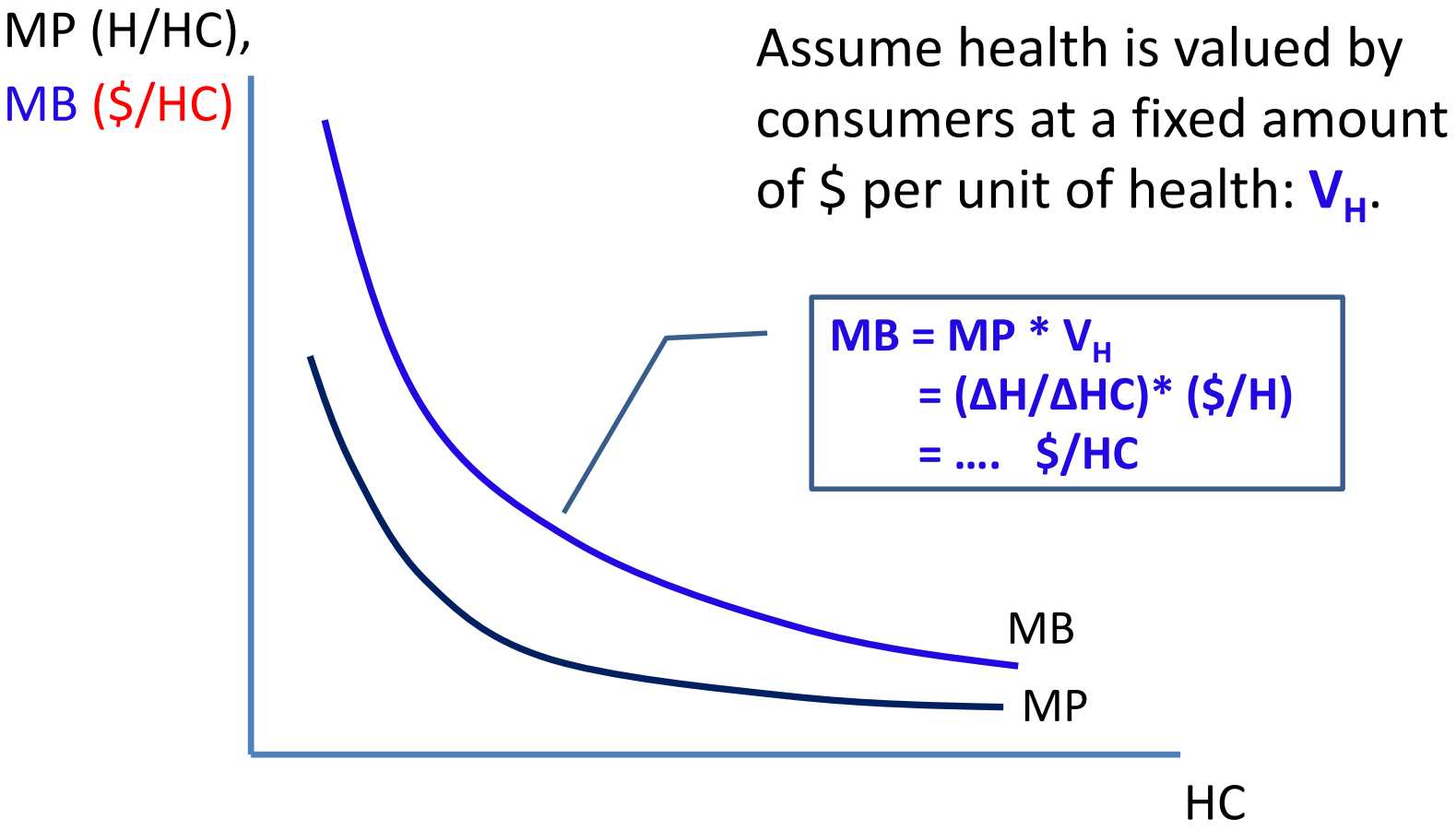
	Health	Health Care	Exercise
A	50	5	5
B	50	4	6.25
C	50	7	5

- Which combination is technically inefficient?
  - ➢

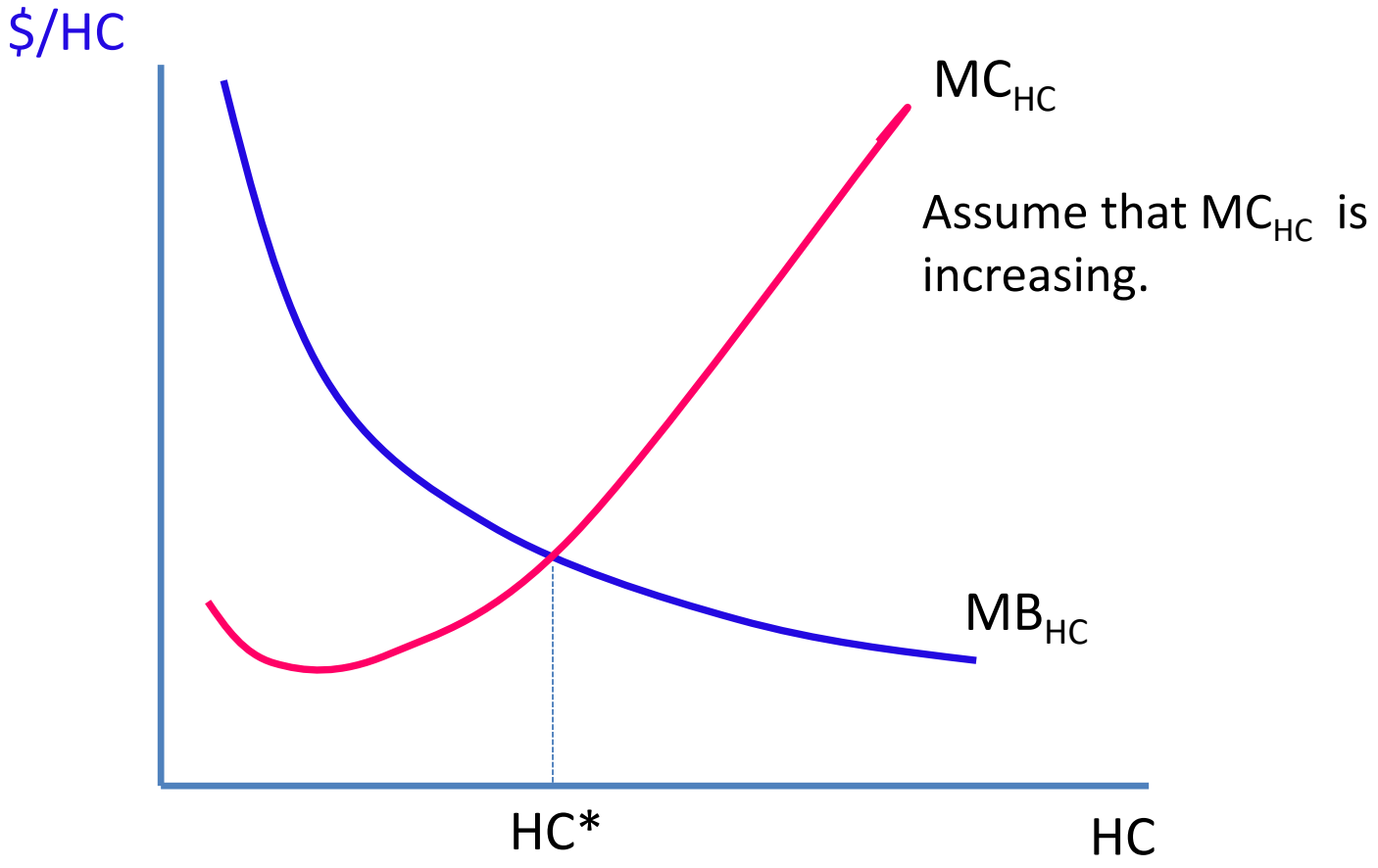
Is Health Care Worth It?

- Now, we turn to the society's perspective on the health production.
- Are we producing on the "*flat of the curve*"?
  - i.e. Is $MP_{\text{health care}} = 0$?
- What is the optimal level of health care for society to produce and use?
  - Need to know:
    - MP of health care
    - How much value of the health generated
    - How much each additional unit of health care costs

Marginal Product and Marginal Benefits of Health Care



Add Marginal Cost Curve



Allocative Efficiency

- Why is HC* optimal?
  - Because it maximizes the net benefit (B-C) of health care.
- If HC < HC*, MB > MC:
  - By consuming more HC, total net benefits increase.
- If HC > HC*, MC > MB:
  - By consuming less HC, total net benefits increase.
- At MB = MC, *allocative efficiency* is achieved.

Allocative Efficiency under Constraints

- Last example illustrates a situation of the unconstrained choice – we could use as much HC as we'd like.
- In reality, due to *scarcity* of resources, any choices are constrained by available resources.
- To achieve allocative efficiency, we need a *new rule* to allocate spending over all the possible inputs for the health production, until the budget is used up.

Constrained Choice

- Rule for allocative efficiency under constraints:
  - Allocate spending over all different inputs for the health production so that *the value of the health gain from the last $ spent on each input is the same*:

$$\frac{MB_{HC}}{MC_{HC}} = \frac{MB_{Exercise}}{MC_{Exercise}} = \ldots = \frac{MB_{Public\ Health}}{MC_{Public\ Health}}$$

- If inequality exists (e.g. $MB_{HC}/MC_{HC} > MB_{Exercise} / MC_{Exercise}$), then spend _____on health care and _____ on exercise.
  - MP of health care will decline & MP of exercise will increase.
  - Eventually, the benefit per $ spent on each input will be equal.

Empirical Evidence on the Relationship between H and HC

- Hadley, J. (1982). *"More Medical Care, Better Health?" An Economic Analysis of Mortality Rates.*
- RAND Health Insurance Experiment (HIE)

Hadley (1982)

- Estimate the impact of health care on health by using county-level data from 1970
- Regression function:

  Mortality rates = f(HC expenditure, educ, income, ..)

- Elasticity of health w.r.t. health care expenditure:

  E = (%ΔMortality rate)/(%ΔHC expenditure)

- Found small but significant elasticities: -0.12 to -0.17
  - A 1% increase in health care expenditure results in a 0.12% to 0.17% reduction in mortality rates.

Possible Biases in Estimating the Relationship between H and HC?

- *Selection bias*
  - In the health production function, we assume that an increase in HC leads to an increase in H.
  - But many people choose to consume more HC when they are sick, i.e. decrease in H causes an increase in HC.
  - This is called *reverse causality bias* → underestimation.
- *Omitted variable* that is correlated with H and HC:
  - Example: "Employment" – People who are employed are more likely to be healthy and use more health care because they have health insurance (or can afford health care).
  - Sometimes, this omitted variable is not observed.

RAND HIE

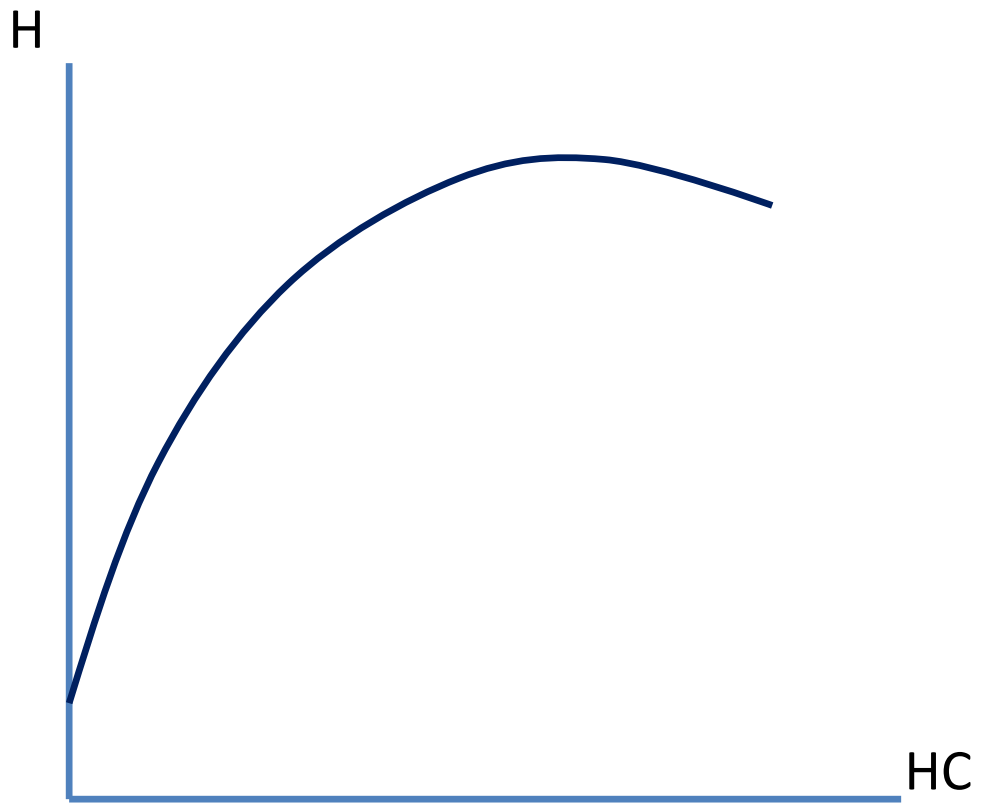
- To reduce the possible biases from observational data, an alternative to use experiments.
  - Natural experiments – expansion of health insurance coverage
  - Randomized controlled trials (RCTs)
- RAND HIE:
  - Designed to test the impact of different health insurance policies on demand for health care and health status
  - Participants are assigned to health insurance plans:
    - c=0, c=0.25, c=0.5, or c= 0.95
  - Found: people assigned to cost sharing spend 40% less on health care, compared to people who pay nothing (c=0).

RAND HIE

- Studies from the experiments show that the increase in health care had no effect on health.
  - *Brook et al.* (1983) found that the decrease in HC caused by cost sharing did not have any effect on H, except for worse corrected vision and worse blood pressure.
  - *Newhouse et al. (1993)* found that 40% increase in health care used by the fully insured had little or no effect on adults' health status (measured from work loss days).

Plan	Mean of Work Loss Days	s.e.
Free (c=0)	5.47	0.42
Intermediate (c=0.25, 0.5, 0.95)	4.82	0.37
Individual deductible	4.54	0.36

Summary of Empirical Evidence



Question:
Where are we, according to Hadley's and RAND HIE's studies?

Fuchs' (1974): Who Shall Live?

- One of the early studies on what inputs produce health—the health production function
- Fuchs' observations:
  - Not until the 20th century that health care had a substantial contribution on health.
  - Most of the gains in health in the 1800s and early 1900s were due to increased income, and improvements in public health (e.g. chlorination of water and pasteurization of milk) and better hygiene.
  - The development of pharmaceutical products (e.g. antibiotic and vaccine) increased health and also increased the productivity of physicians.

Fuchs' (1974): Who Shall Live?

- Fuchs' observations (continued):
  - *Now (at the time of his writing)*, health gains are not associated with income or public health programs
  - Many of the diseases that people are dying of (e.g. heart disease and cancer) *cannot be cured* by medical care.
  - Instead, they can be prevented by consumers following healthy lifestyles.
- Fuchs argued that these diseases were related more to _____ than _____. Thus, *changes in lifestyle are the most productive inputs in the health production function.*

The First Year of Life

- Factors that lower infant mortality rates (early 1900's)
  - Rising living standard, spread of literacy, and education
  - Chlorination of water supply and pasteurization of milk
  - Introduction of sulfonamide (an antimicrobial drug)
  - Decrease in "unwanted" births after 1965
- Other important factors:
  - Prematurity
  - Income
  - Schooling
  - Race (inequality in access to care)
  - Medical care (how it's used and adequacy)

Three Score and Ten

- Major causes of deaths:
  - Age 15-24 –
  - Age 35-44 –
  - Age 45-64 –
- Comparison with Sweden
  - Higher mortality rates in the US
  - Not due to difference in quality and quantity of health care
- Correlation with schooling
  - Good health → more schooling?
  - More schooling → better health?

The “Weaker” Sex

- *Age pattern*
  -
- *Variations in the pattern*
  -
- *Marital status*
  -
  -

A Tale of Two States

- Studied the population health outcomes during 1960s in two adjacent states:
  - Utah –
  - Nevada –

- Showed the "excess" death rates in Nevada compared to those in Utah:
  - Age-specific death rates, by gender and age
  - Cause-specific death rates for liver cirrhosis (associate with heavy drinking) and lung cancer (associate with tobacco smoking)

Excess of Death Rates in Nevada compared with Utah, Average for 1959-61 and 1966-68

Age Group	Males (%)	Females (%)
< 1	42	35
1 -19	16	26
20 – 39	44	42
40 – 49	54	69
50 – 59	38	28
60 – 69	26	17
70 – 79	20	6

Source: Reproduced from Fuchs (1974), Who Shall Live? Health Economics, and Social Choice: Chapter. 2

Excess of Death Rates in Nevada compared with Utah for Cirrhosis of the Liver and Malignant Neoplasm of the Respiratory System for 1966-68

Age Group	Males (%)	Females (%)
20 – 39	590	443
40 – 49	111	296
50 – 59	206	205
60 – 69	117	227

Source: Reproduced from Fuchs (1974), Who Shall Live? Health Economics, and Social Choice: Chapter. 2

Lessons from Fuchs' Study

- The comparison of death rates in the two states show a big difference favoring *Utah.*
  -
- Fuchs' study was the first to put health care spending in the health production function, and to recognize that there might be other and better options for obtaining health than buying additional health care.
  - We could apply allocative efficiency rule.
- This study was path breaking because it contributed to the recognition that we consumers have a great deal of influence on our own health.

Other Inputs in the Health Production

- From Fuchs' study, we saw that lifestyle behavior and environmental pollution affect health.
- Other determinants of health are:
  - Family characteristics:
    -
  - Income:
    -
  - Social capital:
    -
  - Education:
    -

Education and Health

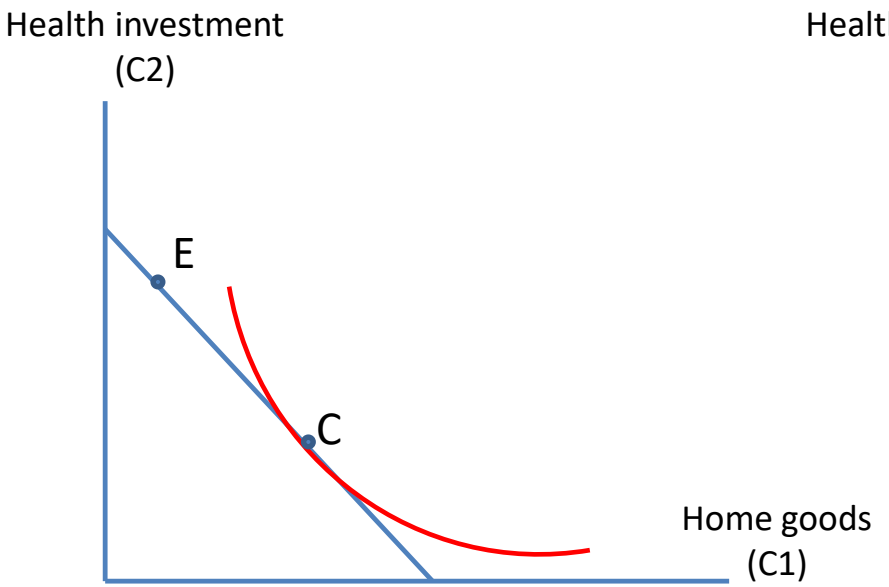
- 2 Theories about the role of schooling:
  - *Michael Grossman's* (1972a, 1972b) theory of demand: Better-educated persons tend to be economically more efficient producers of health status.
  - *Victor Fuchs* (1982): People who seek out additional education tend to be those with lower discount rates, and at the same time people with lower discount rates will be more likely to invest in education and in health as well.
- Empirical studies support the argument that education makes persons more efficient producers of health (Lleras-Muney, 2002).

Appendix: Time Preference and Health

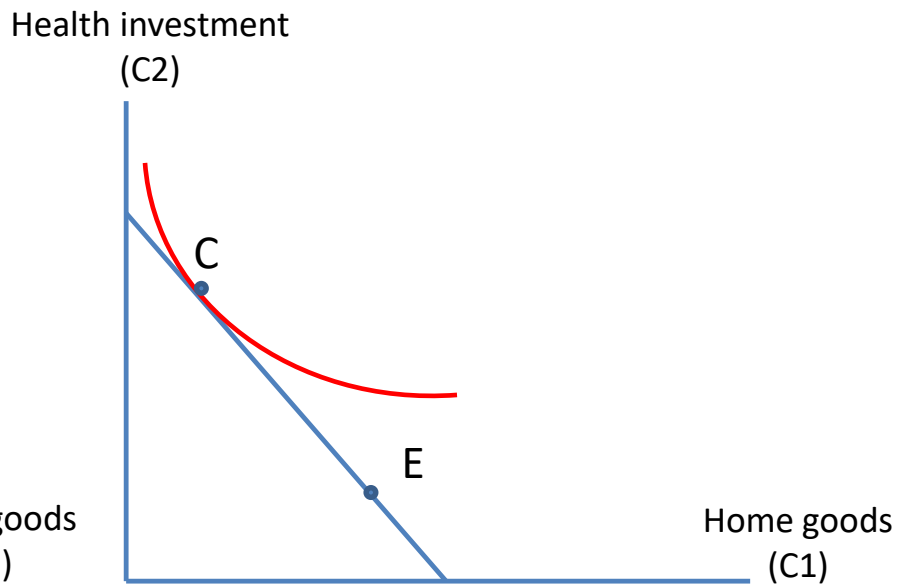
- Time preference refers to the consumer's preference for *current consumption* over *future consumption*.
- E.g. U(C1,C2) = u(c1) + βu(c2)
  - Where C1 = current consumption, C2 = future consumption
  - β is the discount rate.
  - *High* rate of time preference
    - Place a large value on current consumption relative to future consumption → low health investment
    - Large discount rate (i.e. less patient)
  - *Low* rate of time preference
    - Place a low value on current consumption relative to future consumption → high health investment
    - Small discount rate (i.e. more patient)

Health Investment vs. Home goods

- Think of home goods as ‘current consumption’ and ‘health investment’ as ‘future consumption’



High rate of time preference



Low rate of time preference

Fuchs (1982): Time Preference and Health

- Attempts to explain the correlation between schooling and health
  - Empirical evidence: positive and significant impacts of schooling on health
  - What is the mechanism?
- Grossman:

More years of schooling make the individual a more efficient producer of health.

- Fuchs:

The concept of time preference (trade-off between *current cost* and *future benefit*) could explain possible links between schooling and health.

Fuchs' argument

- There are 2 possible ways:
- 1. Suppose that differences in time preference are established early in life and do affect subsequent behaviors. Individuals with low discount rate (low time preference) are more likely to invest in both education and health. (i.e. Both education and health are correlated with low time preference.)
- 2. Education affects time preference. More schooling make people more willing to invest at a lower rate of return. Thus, more schooling could result in more investment in health.