Determinants of Population Health
Hurley, Chapter 6

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Economics 318

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A production function for health

- Recall our framework modeling a person (or a population's) health as a function of the causes of health
- A stylized health production function

$$HS = f(HC, L, E, G) \tag{1}$$

where HS is health status, L is lifestyle, E is environment, and G is genetics.

- This is just fancytalk to note that health generally changes when, other things being equal, lifestyle, environment, genetic makeup, or care changes.

production function cont

- Once we have nailed down the specifics of what we mean, we can think about health status as a produced output much like, say, widgets in micro theory.
- (graphs of total and marginal health products).
- We have already discussed what Hurley refers to as the "social gradient in health," that is, that higher income people tend to be healthier.

What has changed health status over the last several centuries?

- Health care is not as important a determinant of health as you might think.
- Improvements in health care technology are not as important as you might think in explaining why we're healthier than people in, say, the year 1800.

McKeown Thesis

The enormous gains in population health that occurred over the last 300 years were largely due to better living standards, notably nutrition, not improvements in medical technology nor designed public health interventions.

World population over time

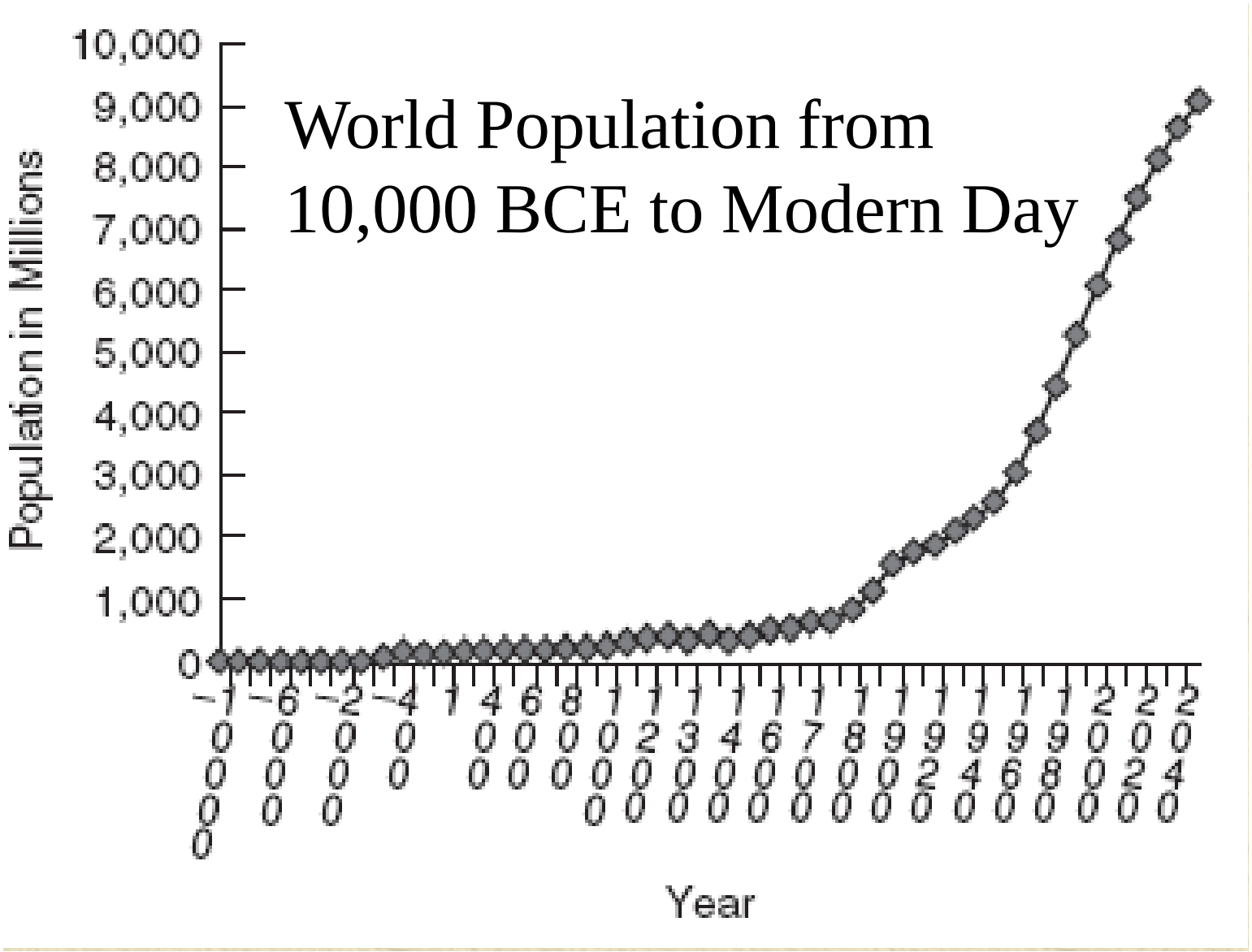
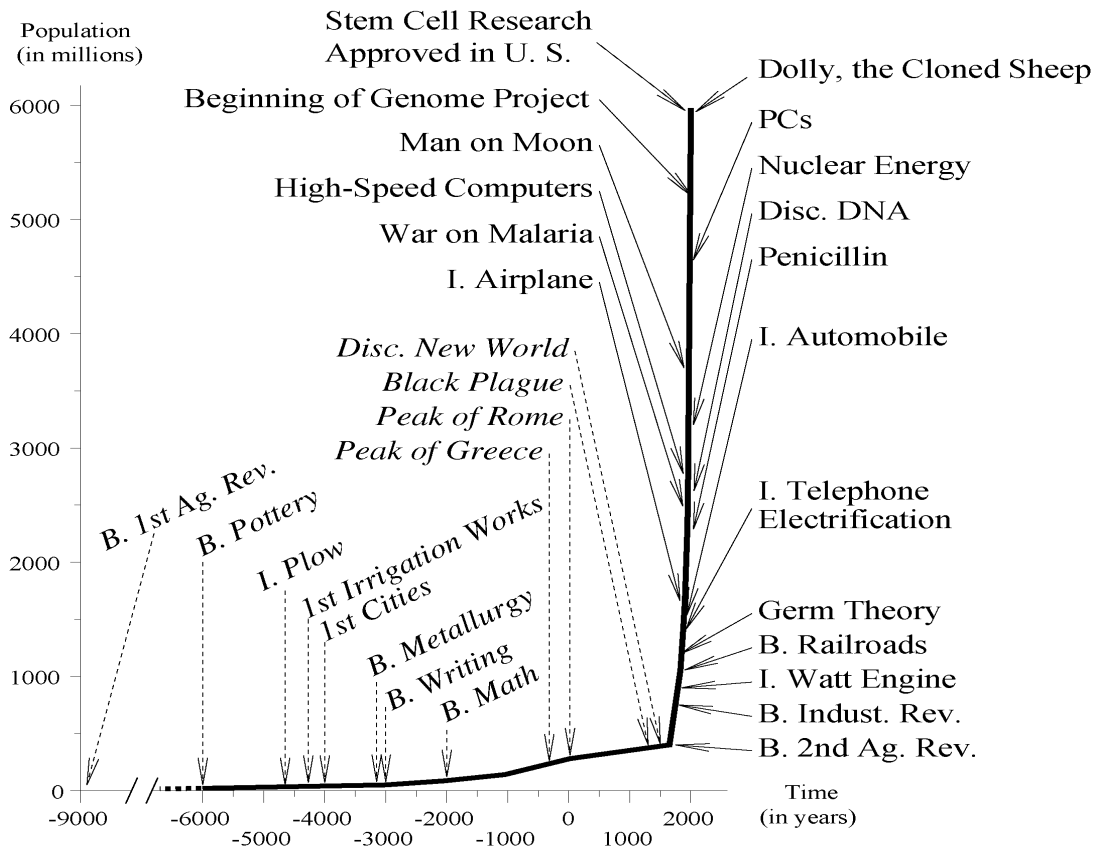


Figure 2
The Growth of World Population and Some Major Events in the History of Technology

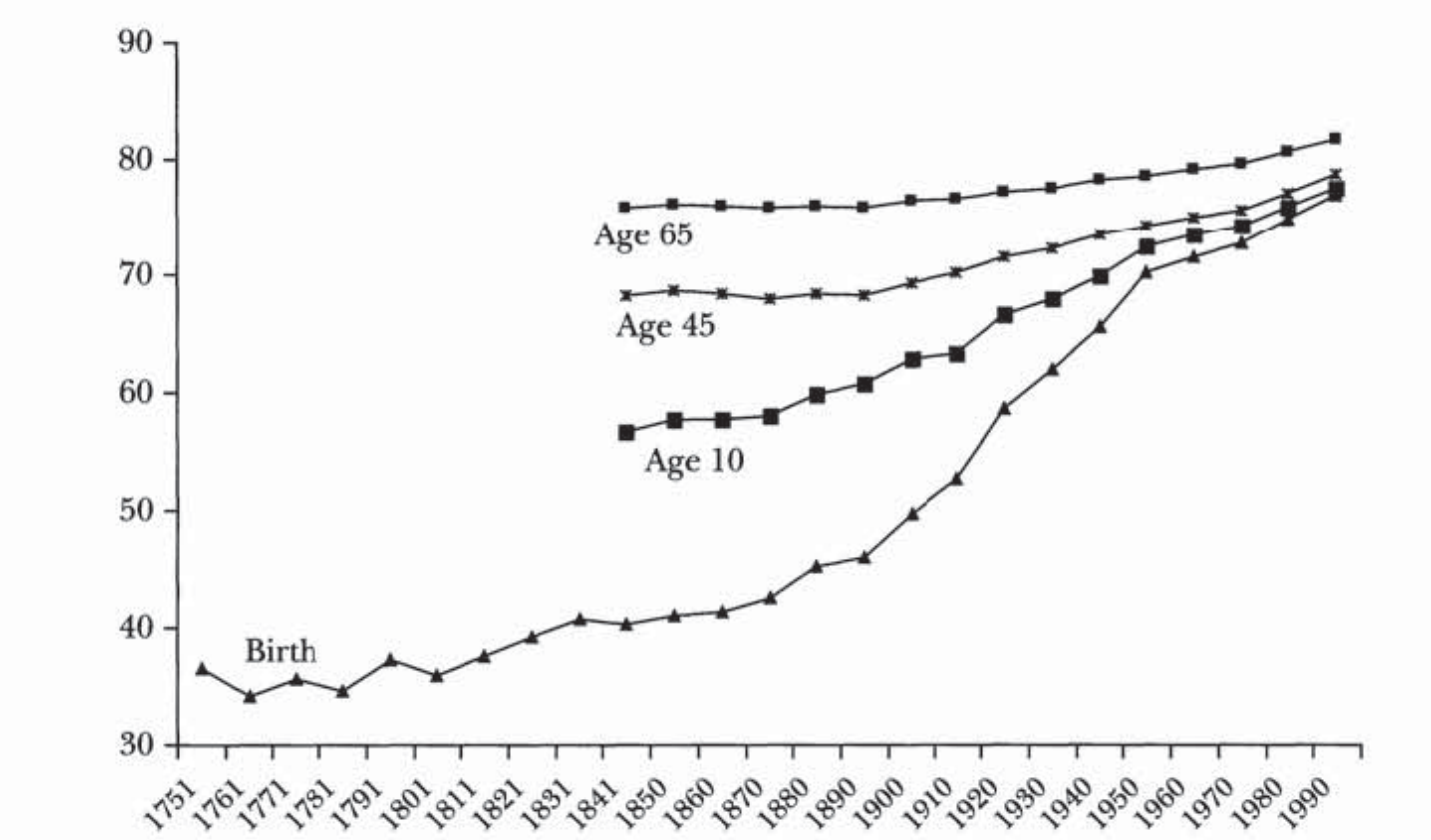


Sources: Cipolla 1974; Clark 1961; Fagan 1977; McNeill 1971; Piggott 1965; Derry and Williams 1960; Trewartha 1969. See also Allen 1992, 1994; Slicher van Bath 1963; Wrigley 1987.

Note: There is usually a lag between the invention (I) of a process or a machine and its general application to production. "Beginning" (B) usually means the earliest stage of this diffusion process.

Changes in conditional life expectancy, England and Wales

Figure 6.1: Life Expectancy, England and Wales, 1750-2000



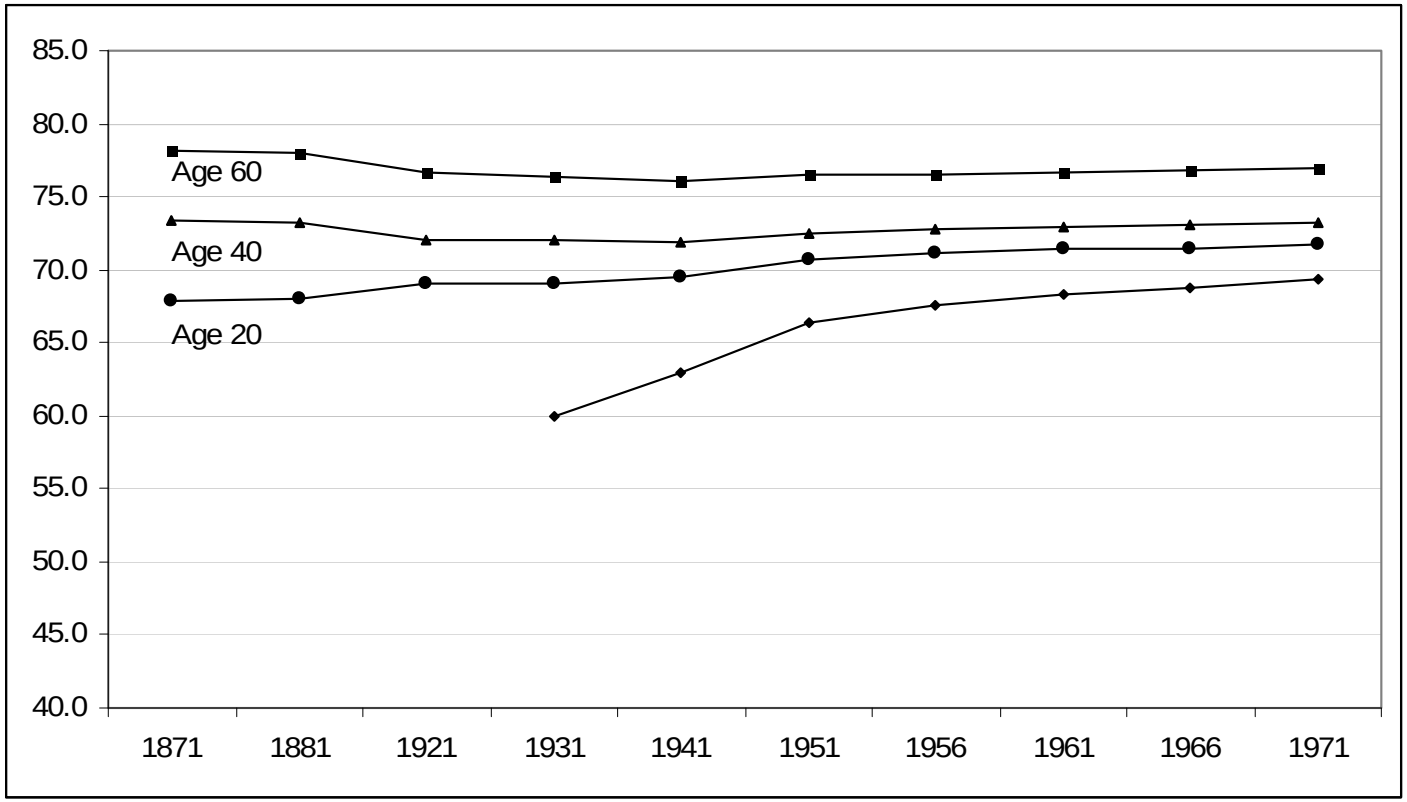
Source: Data for 1751–1841 are from Wrigley and Schofield (1981, Table 7.15, p. 230); data from 1841 are from the Human Mortality Database.

Source: Cutler et al. (2006).

Figure 6.1. These data from England and Wales document the substantial increases in life

Life expectancy in Canada

Figure 6.2: Male Life Expectancy at Various Ages, Canada, 1921-1974



Source: Statistics Canada (1983), Table B65-74

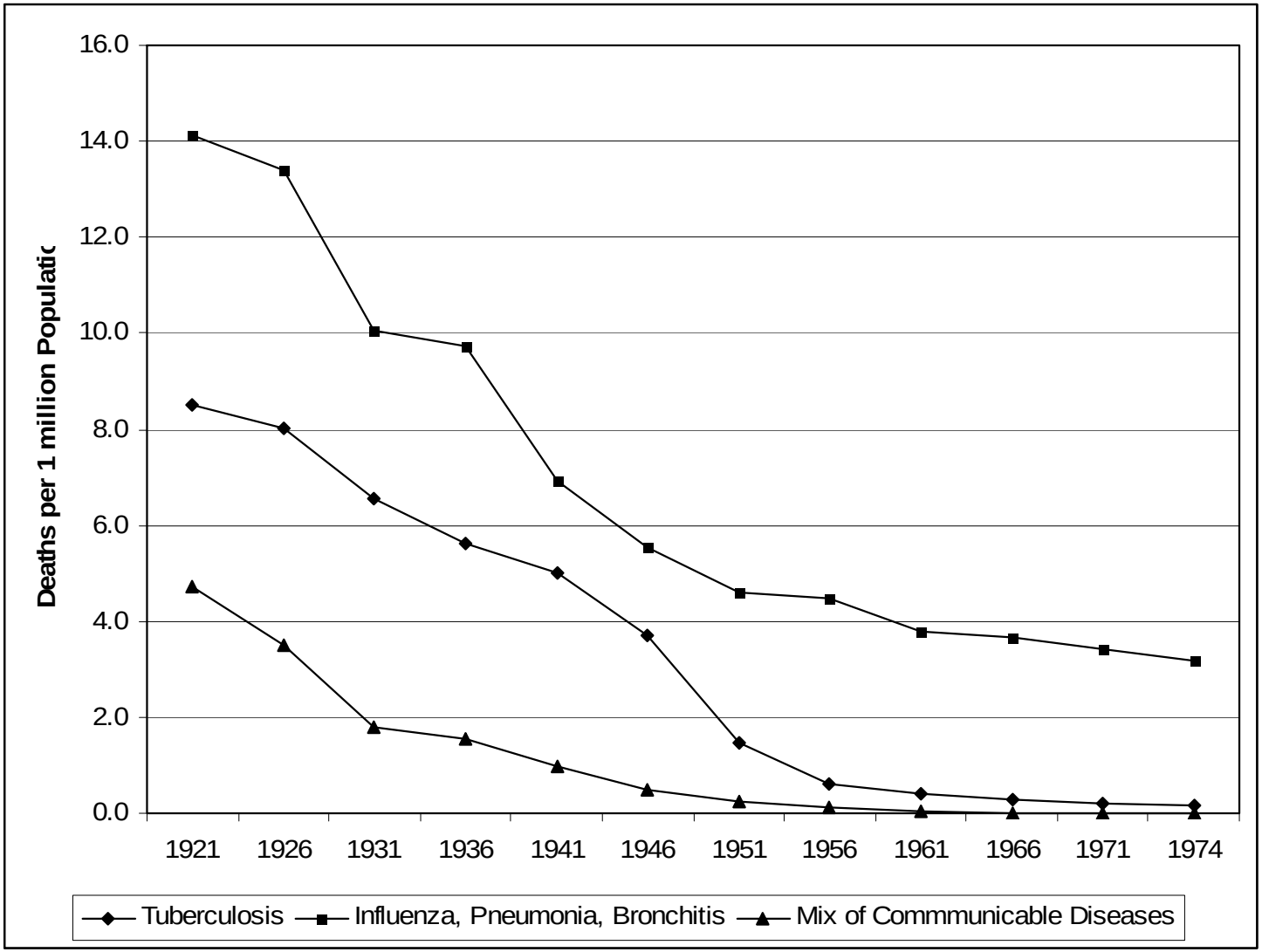
Figure 6.2. Life expectancy at birth among Canadian males rose rapidly up into the 1950s after which the rate slowed. Life expectancy at older ages rose very modestly over this period, implying that most of the gains were achieved among those of younger ages.

World income over time

Source: Gregory Clark, *A Farewell to Alms: A Brief Economic History of the World*

Death rates, Canada

Figure 6.4: Annual Death Rates, Selected Diseases, Canada, 1921-1974



Source: Statistics Canada (1983), Table B35-50.

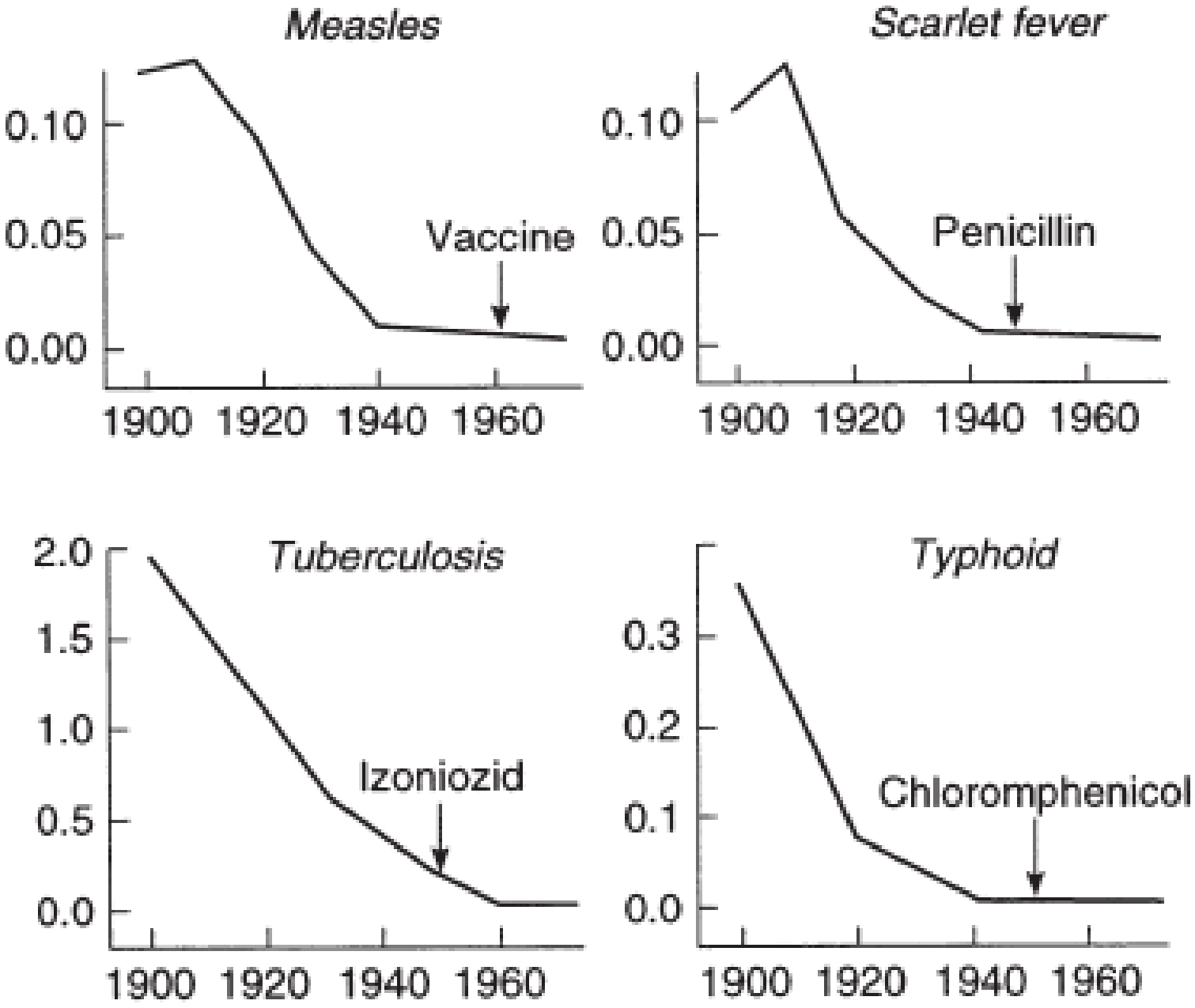
What causes of death have changed?

	1848–1854	1901	1971	Percentage of Reduction (1848–1854 to 1971) Attributable to Each Category	For Each Category, Percentage of Reduction (1848–1854 to 1971) That Occurred Before 1901
I. Conditions attributable to microorganisms:					
1. Airborne diseases	7,259	5,122	619	39	32
2. Water- and foodborne diseases	3,562	1,931	35	21	46
3. Other conditions	2,144	1,415	60	12	35
Total	12,965	8,468	714	72	37
II. Conditions not attributable to microorganisms	8,891	8,490	4,070	28	8
All diseases	21,856	16,958	5,384	100	29

*Standardized to the age/sex distribution of the 1901 population.

Source: Reprinted from McKeown, Thomas, *The Modern Rise of Population.* New York: Academic Press. 1976 (p. 54).

Which disease rates have changed over time?



What are the major reasons we're healthier today?

- **Not** improvements in health care technology or health care access.
- Increases in living standards, notably, nutrition.
- Sanitation and other public health interventions probably also very important.

Reasons we're healthier, cont.

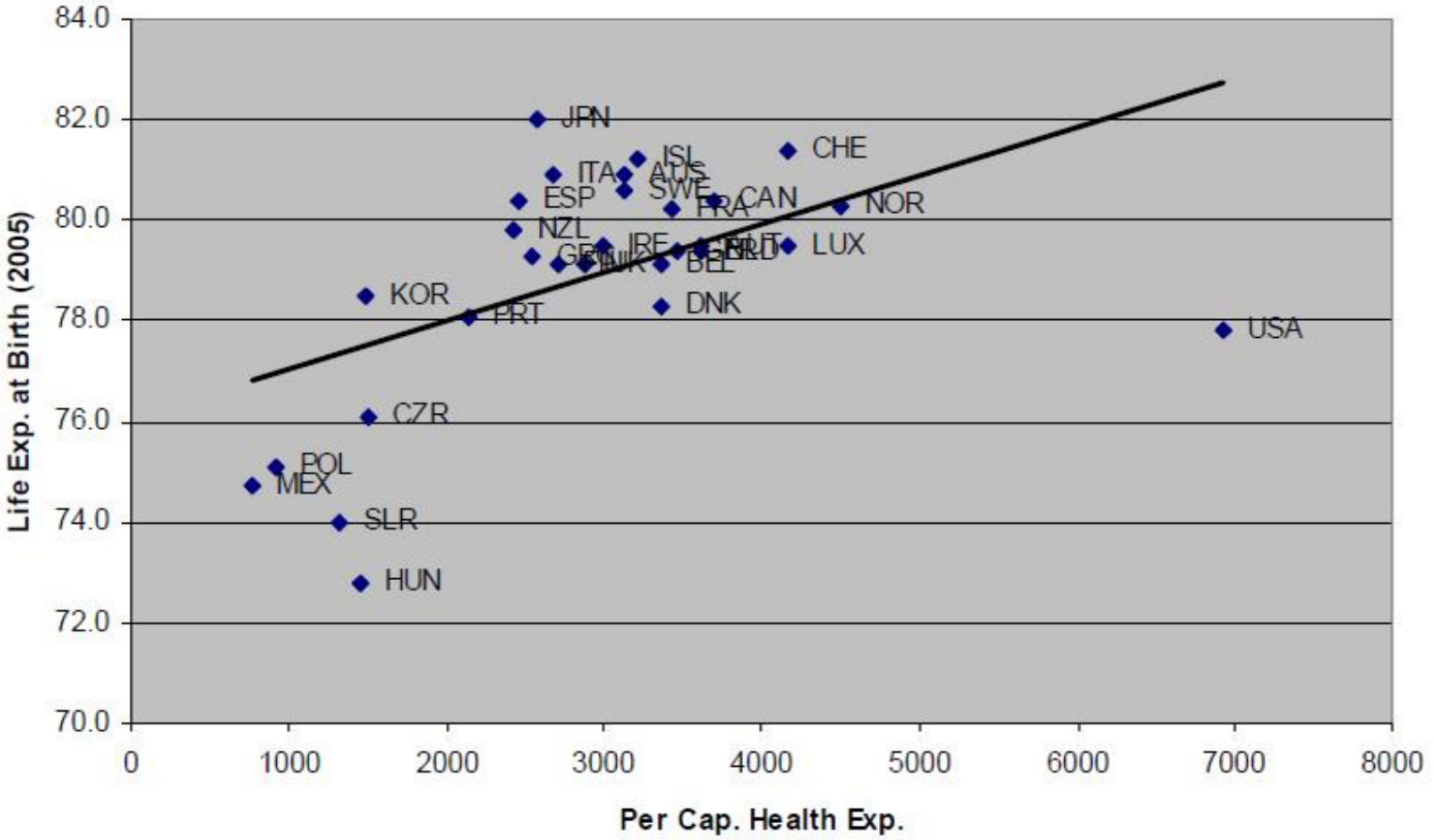
- Cutler and Miller (2005): large-scale water purification responsible for 1/2 the reduction in U.S. mortality, 1900-1936. Benefit to cost ratio: 23.
- An important reason: $\uparrow$ nutrition $\rightarrow \uparrow$ disease resistence
- Indirect causes: increases in economic well-being, education, literacy.

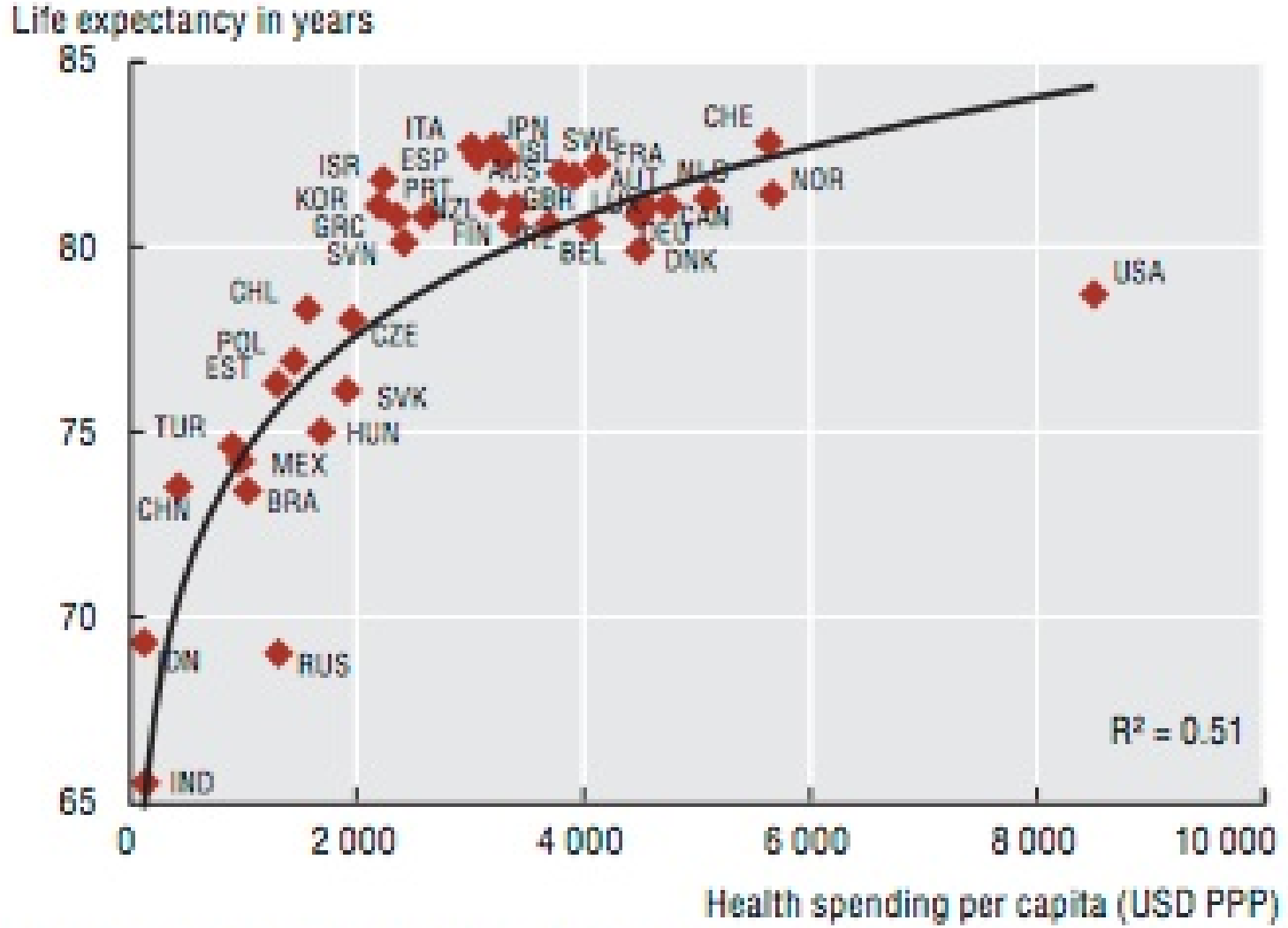
Contribution of medical research.

- Although not major cause, health care technology improvements do improve health.
- Important technologies: antibiotics, cardiovascular treatments, vaccines, neonatal care.
- Murphy and Topel (2005) estimate the economic value of improvements to health in the U.S. since 1970 amount to roughly $3.2 TRILLION per year.
- If improvements in health were included in GDP, increment in GDP since 1970 would be almost 50% higher.

Contribution of medical research cont.

- These changes could have been largely due to factors other than health technology, but even if health technology is only a small contributor, probably worth the expense.
- But: We ought to be skeptical regarding the marginal effectiveness of health care expenditures, as we will see.
- The contribution of public health (clean water, etc) may have more relevance in the lesser developed world.
- How much is due to expenditures on health care?





Source: OECD Health Statistics 2013, http://dx.doi.org/10.1787/health-data-en; World Bank for non-OECD countries.

StatLink http://dx.doi.org/10.1787/888932916040

Measuring the effect of health expenditures on health: fallacy

- **"The U.S. spends more on health care than Canada does, but life expectancies are about the same or higher in Canada. Therefore, Canada's health care system is more efficient."**
- The conclusion may be true, but it does not follow from that evidence.

Another fallacy.

- Can we just look across countries and correlate health expenditures with health outcomes?
- No, for our usual correlation-does-not-imply-causation reasons.
- e.g.: a bad health shock (e.g. an epidemic) occurs in a country, leading to more expenditures to counter the shock.
- We may see this country with both higher expenditures and lower health, but health would have been even worse with lower expenditures.

Effect of health care expenditures on health outcomes

- Suppose we try to estimate the elasticity of health to health expenditures.
- Here by "health" we mean some measure of population health and expenditures are aggregate expenditures on medical inputs.
- The elasticity is

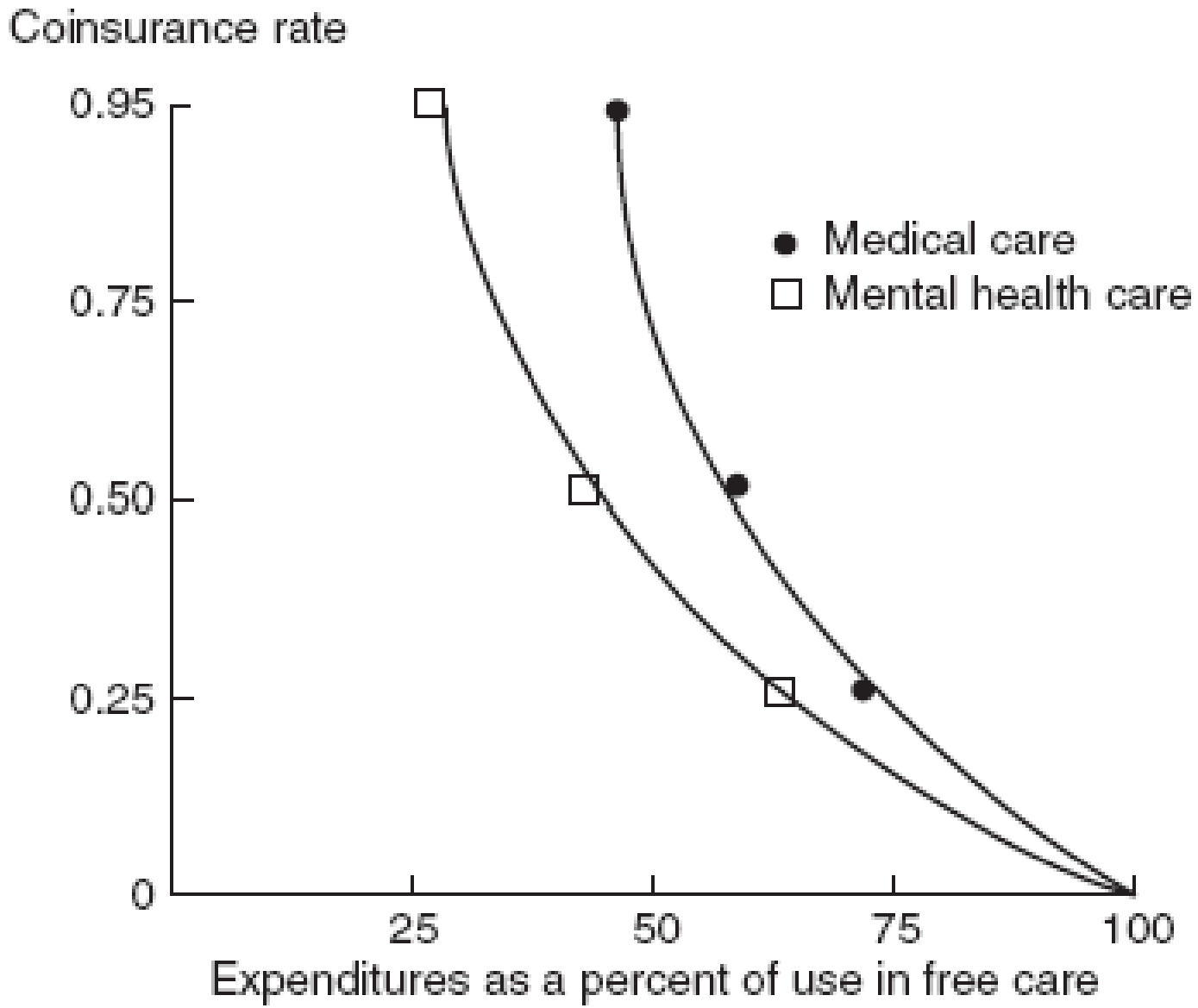
$$\text{elasticity} = \frac{\%\text{ change in health}}{\%\text{ change in expenditures}} \tag{2}$$

Effect of expenditures cont.

- Lots of studies try to estimate this effect.
- Surprisingly difficult to find any effect at all!
- A reasonable guess for the U.S. is that the elasticity is perhaps around 0.10 (a 10% increase in expenditures causes a 1% increase in life expectancy).
- Lots of uncertainty.
- Notice this is a **marginal** effect we're trying to estimate.
- Some evidence suggests pharmaceuticals, and improvements in pharmaceuticals, have substantial effects.

Evidence from the RAND health insurance experiment.

- Recall the controlled experiment, conducted in the 1970s and 80s, randomized co-insurance rates.
- Overcomes problem with observational data: non-random assignment of insurance.
- Health care use was sensitive to the co-insurance rate.
- If it is the true that, at the margin, more health care causes more health, we should see people randomized to low care prices in better health.
- We don't!



Evidence from the Oregon Health Insurance Experiment.

- Current research on recent natural experiment.
- Relatively poor and unhealthy people randomly offered Medicaid, n=8,704 randomly received insurance.
- People randomized to insurance used more care and had better physical and mental health.
- But 2/3 of this effect occurred before any treatment could occur, so apparently a result of lower stress from having insurance.

Other inputs.

- If at the margin health care has small effects on health, what does determine differences in health across people, across time, and across regions?
- Lifestyle is important (smoking, exercise, diet, sleep, and so on).
- What determines lifestyle, very broadly defined.
- "Social determinants of health," basically the arguments in our production function other than genetics and health care.

Social capital.

- Nebulous concept, but roughly means the amount of interaction a person has with their family, friends, and community.
- Social capital may directly cause health if it reduces stress.
- More capital may also provide information on effective health–promotion strategies.
- More capital may lead a person to reevaluate health–damaging behaviors.
- Difficult to determine causation.

Social interactions.

- Economists have long studied how people interact in markets, but non–market interactions may be much more important in determining health.
- Social interactions may also directly and indirectly affect health.
- e.g., whether you smoke depends on how many people around you smoke.

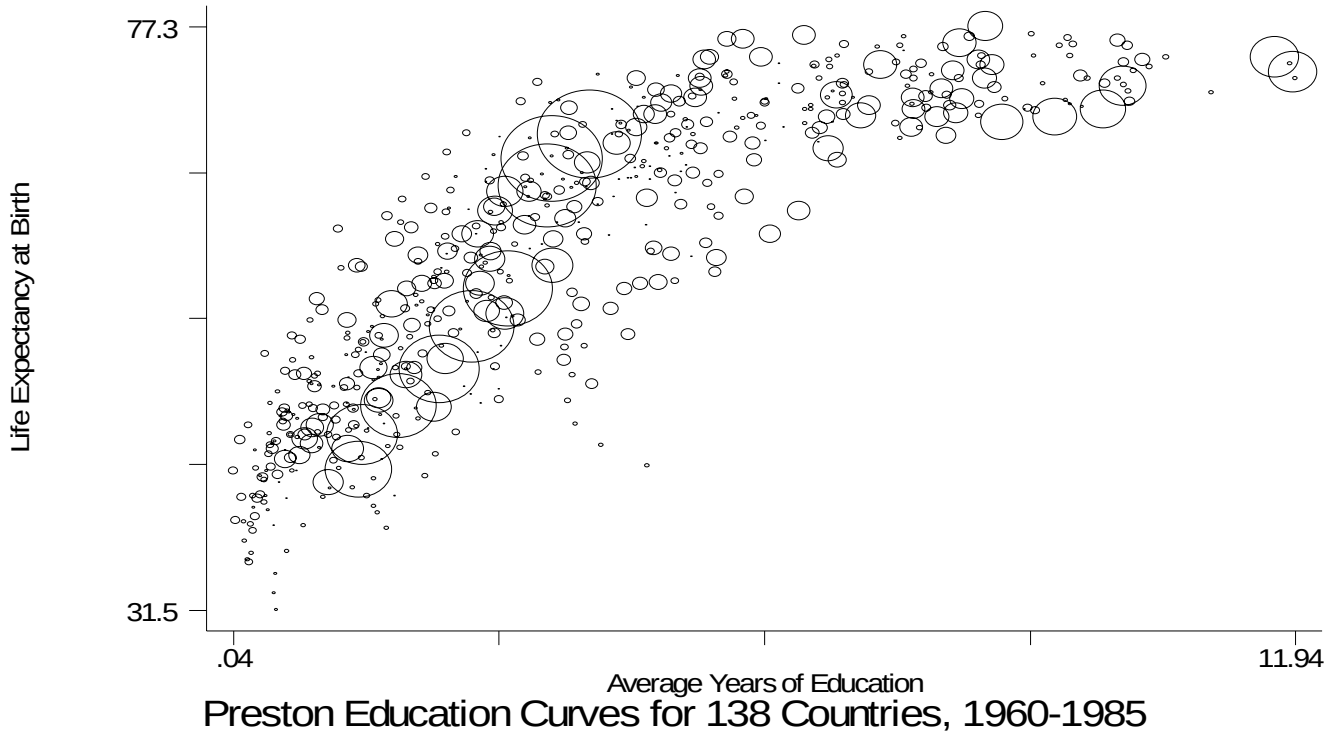
Education and health (Hurley, chap 5, pp142-146.

- Very well-established that there is a positive correlation between health and education.
- We have already discussed education in the context of Grossman's model of health capital.
- Recall: In that model, education makes us more better producers of health, or changes our preferences, or allows us to choose better combinations of inputs.

Plausible that education causes health.

- Education increases income and income increases health (indirect effect).
- More educated have "better" jobs with safer work environments.
- Education allows more efficient production of health through increased information. e.g., more educated more likely to be aware of, and demand, new treatments.
- Education increases intelligence and more intelligent people are better at producing health (critical thinking, more open to science).
- Education leads to healthier behaviors because: different social environments, change in time preference, different social networks.

Figure 1: The relationship between education and life expectancy across countries



Note: Circle size proportional to country population. Authors' calculation using the Barro-Lee international data.

Table 5.2: Education-Health Gradient, Canada, 2005

	Less than High School Degree	High School Graduate	University Graduate
Self Assessed Health Status			
Excellent	16.8%	21.5%	29.8%
Very Good	33.4%	39.5%	42.2%
Good	32.2%	29.0%	22.5%
Fair	13.2%	7.6%	4.3%
Poor	4.4%	2.4%	1.2%
Total	100%	100%	100%
Number of Chronic Conditions			
0	30.7%	30.3%	34.1%
1	23.7%	26.1%	28.7%
2-3	27.8%	28.3%	26.7%
More than 3	17.8%	15.2%	10.5%
Total	100%	100%	100%

Source: Author's calculation, Canadian Community Health Survey, 3.1 (Statistics Canada 2009)

Table 5.2. The average health status of individuals, in this case measured by their self-assessed health status and their number of chronic health conditions, increases the greater is their level of education.

Reverse causation and third variables.

- That more educated people tend to be healthier is not good evidence that our theory that education causes health is true.
- Could also be the case that: healthier people tend to get more education, or other variables lead to both more education and more health.

Example of third variable: temporal discount rate

- How much is \$100 one year from you worth today?
- If your bank offers you an interest rate r, you would have \$100 in one year if you invested $100/(1+r)$ today.
- So one answer is $100/(1+r)$, or a per dollar rate of $\beta = (1/(1+r))$. This is a discount rate.

Subjective discount rates.

- But generally you may personally value future outcomes at a different rate than that implied by the market interest rate.
- Suppose you live for the day: you set $\beta = 0$. \$100 in one year is worth nothing to you today.
- You will not do things which have costs today and lead to benefits in the future, because you don't care about the future.
- Investing in health and education involve current costs and future benefits.

Subjective discount rates cont.

- So, even if people were alike in all respects except discount rates, and even if health does not cause education nor vice versa, we would see a correlation between health and education.
- There may be many other personality, background, genetic, and contextual variables which lead to both education and health.

Reverse causation from health to education.

- There is good evidence that poor health causes lower education.
- e.g. kids who randomly received effective health treatments in Kenya went on to get more schooling.
- We have good evidence that this is part of the reason health and education are correlated.

Econometric evidence on effect of education on health.

- Try to find essentially random changes in schooling to infer causation.
- e.g., change in compulsory schooling from 14 to 15 years. It is as if some people have been randomly assigned to get an extra year of schooling.
- Result: additional year of education reduces probability of death by 3.6%.
- Evidence from these studies suggests the effect of schooling on health is positive but much lower than the correlational evidence would suggest.

Education and health cont.

- That result implies that some other factor causes people to both choose higher levels of schooling and to be in better health.
- Suppose the government wants to increase health: not clear whether to spend more on health care or on education!

Policy implications.

- Labor market return to a year of education: about 10% $\approx$ \$80k.
- Health return to a year of education: about \$30k.
- To the extent people do not demand enough education, better case for educational subsidies.
- Possible health returns to subsidizing education are comparable to returns from health care system.