

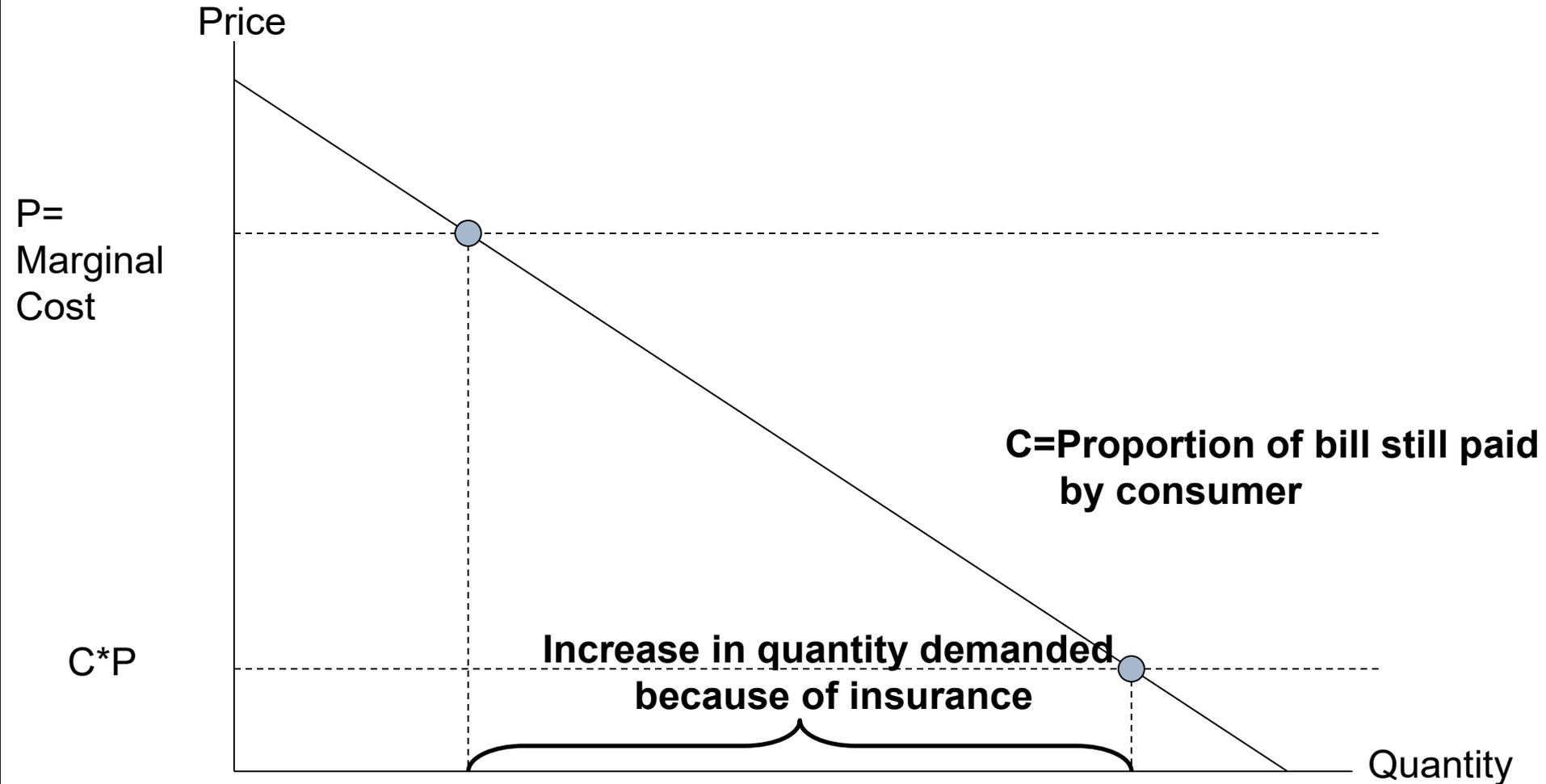


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Demand for health: The Grossman model

Lecture 3

Review Effect of Coinsurance



Oregon Natural Experiment

Lottery for Medicaid

90,000 applied

10,000 got in

More Utilization

30% more outpatient services

35% more hospital services

40% more ER use



Health effects of Oregon

EXHIBIT 4.5

Physical Health Results in the Baicker and Colleagues Study

Variable	Mean Value in Control Group	Change with Medicaid Coverage (95% CI)	P Value
Blood pressure			
Systolic (mm Hg)	119.3±16.9	-0.52 (-2.97 to 1.93)	0.68
Diastolic (mm Hg)	76.0±12.1	-0.81 (-2.65 to 1.04)	0.39
Elevated (%)	16.3	-1.33 (-7.16 to 4.49)	0.65
Hypertension			
Diagnosis after lottery (%)	5.6	1.76 (-1.89 to 5.40)	0.34
Current use of medication for hypertension (%)	13.9	0.66 (-4.48 to 5.80)	0.80
Cholesterol			
Total level (mg/dl)	204.1±34.0	2.20 (-3.44 to 7.84)	0.45
High total level (%)	14.1	-2.43 (-7.75 to 2.89)	0.37
HDL level (mg/dl)	47.6±13.1	0.83 (-1.31 to 2.98)	0.45
Low HDL level (%)	28.0	-2.82 (-10.28 to 4.64)	0.46
Hypercholesterolemia			
Diagnosis after lottery (%)	6.1	2.39 (-1.52 to 6.29)	0.23
Current use of medication for high cholesterol level (%)	8.5	3.80 (-0.75 to 8.35)	0.10
Glycated hemoglobin			
Level (%)	5.3±0.6	0.01 (-0.09 to 0.11)	0.82
Level ≥6.5% (%)	5.1	-0.93 (-4.44 to 2.59)	0.61
Diabetes			
Diagnosis after lottery (%)	1.1	3.83 (1.93 to 5.73)	<0.001
Current use of medication for diabetes (%)	6.4	5.43 (1.39 to 9.48)	0.008
Depression			
Positive screening result (%)	30.0	-9.15 (-16.70 to -1.60)	0.02
Diagnosis after lottery (%)	4.8	3.81 (0.15 to 7.46)	0.04
Current use of medication for depression (%)	16.8	5.49 (-0.46 to 11.45)	0.07
Framingham risk score (%)			
Overall	8.2±7.5	-0.21 (-1.56 to 1.15)	0.76
High-risk diagnosis	11.6±8.3	1.63 (-1.11 to 4.37)	0.24
Age of 50-64 yr	13.9±8.2	-0.37 (-2.64 to 1.90)	0.75

Source: Baicker et al. (2013). Used with permission.

Overview of lecture*

- Grossman model of the demand for health
- Complex model-simple implications
 - Focus on the implications
- How some key variables affect the level of demand (wage, educations, age etc)
-

*Acknowledgements: I am indebted to John Bridges, Michael Grossman, Paul Dolan for materials that they supplied for this lecture



Objectives

- The difference between health and health care
- The benefits of health
- The basic model
 - Effects of wages
 - Effects of time horizon
- Investment and consumption models

General background: Health Production

- Health is *produced* by many factors
 - Genetics, social class, work environment, employment status, wealth, housing
 - Education, smoking, drug use, diet, health care utilisation and lifestyle
 - Sanitation, safe food, safe water, safe streets, health information, sin taxes
- Economists will model *production choices*
- Which of the above health determinants are chosen?
- Who chooses?

The need for a model of health demand

- Market Failure=Underprovided altruistic public good:
- Non-excludable, non-rival concern that vulnerable people deserve better health
 - Policies say find the vulnerable and help them BUT....
- If inequities in health are cause by variations in the basic demand for health, then strategies to improve health undo themselves
 - Public health care will crowd out private health care expenditures or cause risk taking
 - “Obamacare?” “Yes and I’ll have fries with that”

The economics of the household

- In 1965 Gary Becker revolutionized the way that we viewed consumption issues of household goods
- For Becker, households were as much producers as consumers
- Households buy market goods and combine them with time to produce commodities
 - Good : Commodity=Bed :Sleep=TV : Amusement

Michael Grossman



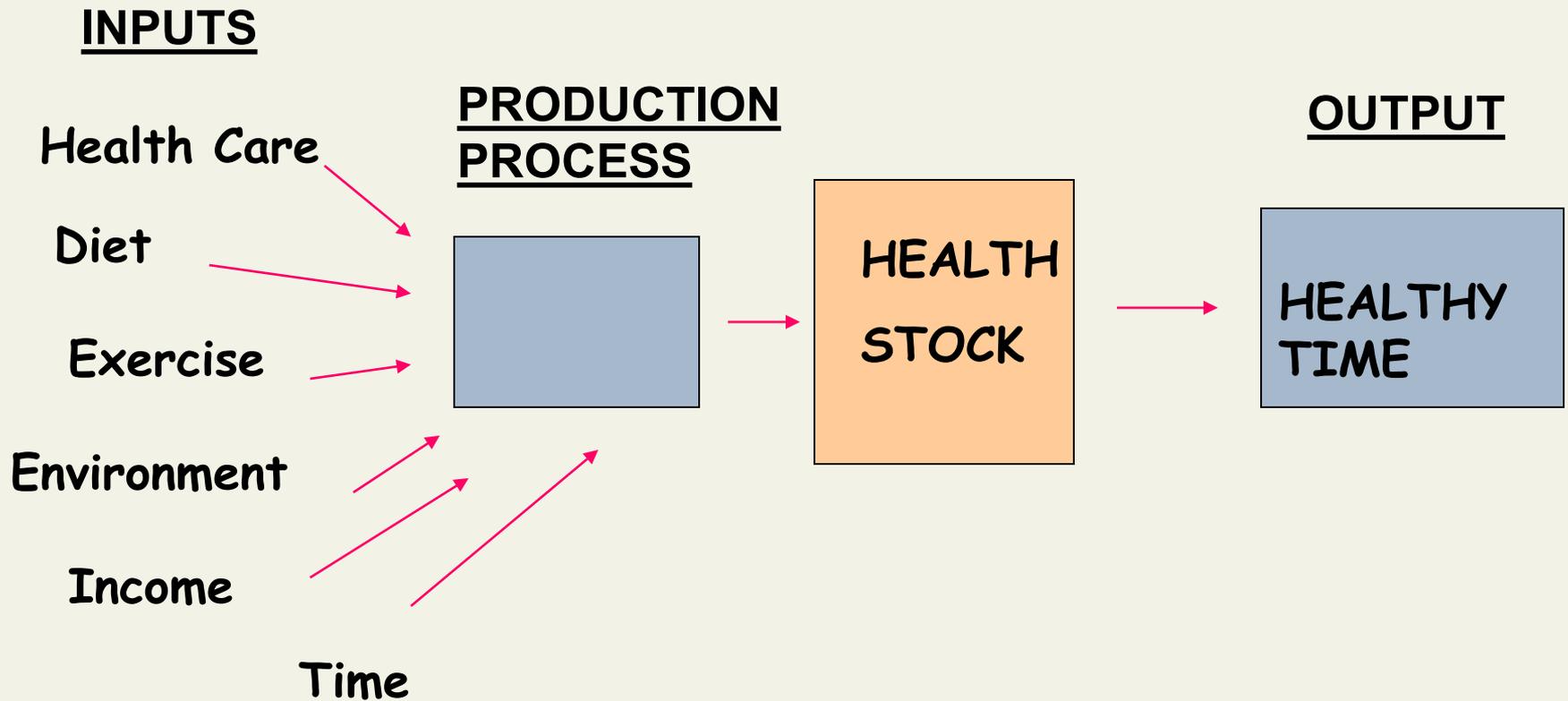
Background to Grossman

- Using the Becker framework, Grossman (JPE, 1972) was concerned with how individuals allocate their resources to produce health
- The model goes beyond traditional demand analysis and has been extremely influential in health economics and among international agencies like the world bank and WHO
- It utilises the idea of the individual as a producer of health (not simply a consumer)
- Modern health economists haven't gone beyond this concept—too bad!
 - Criticisms of a focus on the individual?

Key concepts

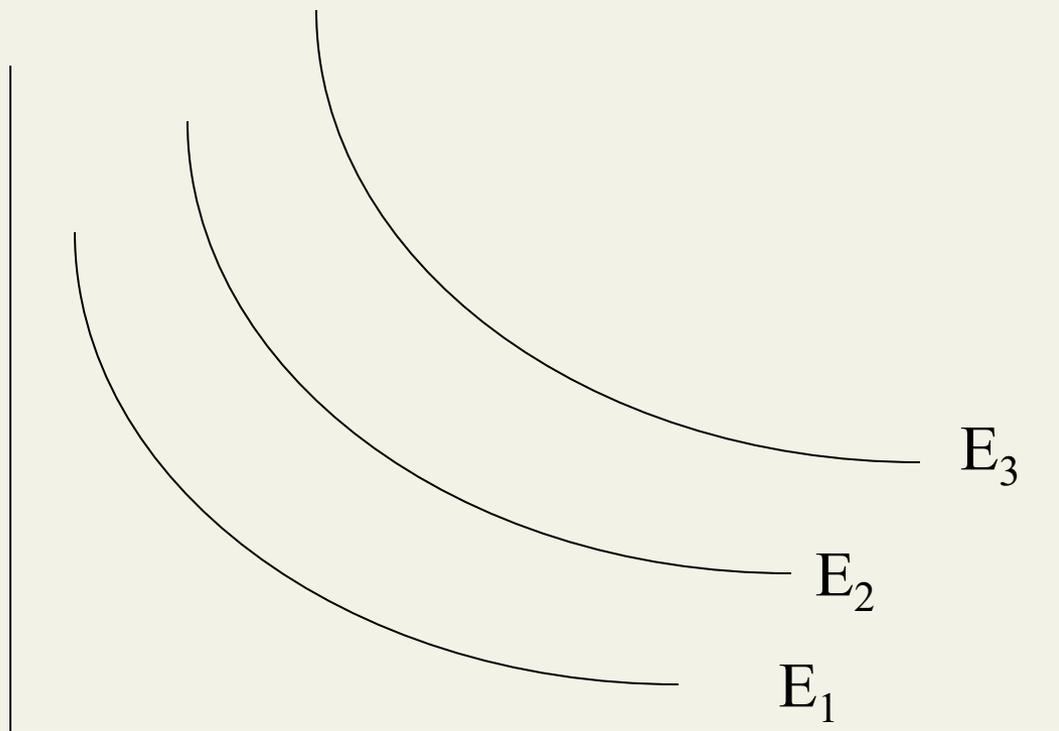
- Demand for health care is derived
 - from a demand for health (few people want health care for its own sake)
- Demand for health is derived
 - from the demand for utility (e.g. healthy days in which to participate in leisure and work)
- Individuals are not passive consumers of health
 - but active producers who spend time and money on the production of health
- Health can be seen as lasting over time periods.
 - It depreciates (perhaps at a non-constant rate) and can therefore be analysed as a capital good

Investing in health



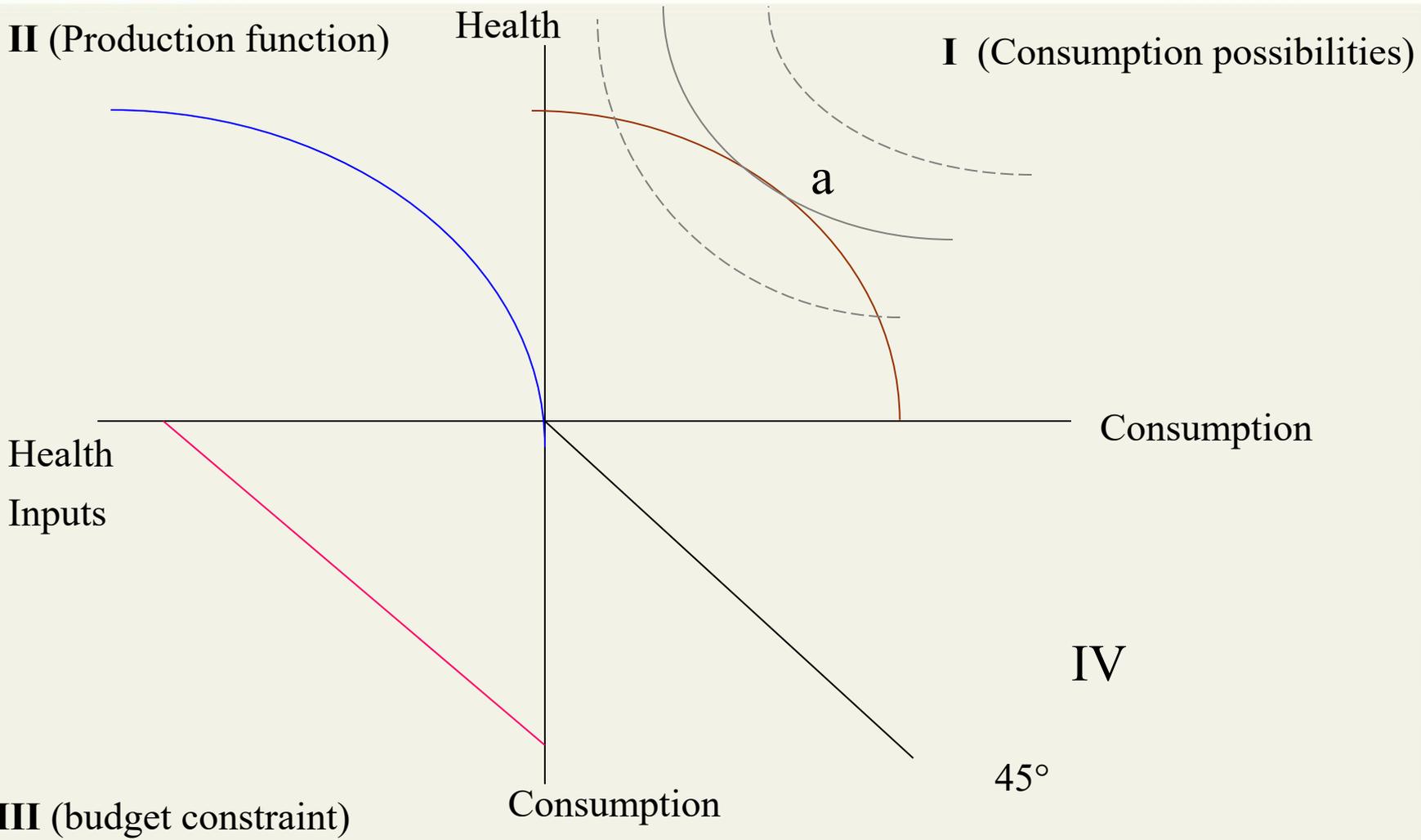
Isoquant version

Vegetables
Consumed

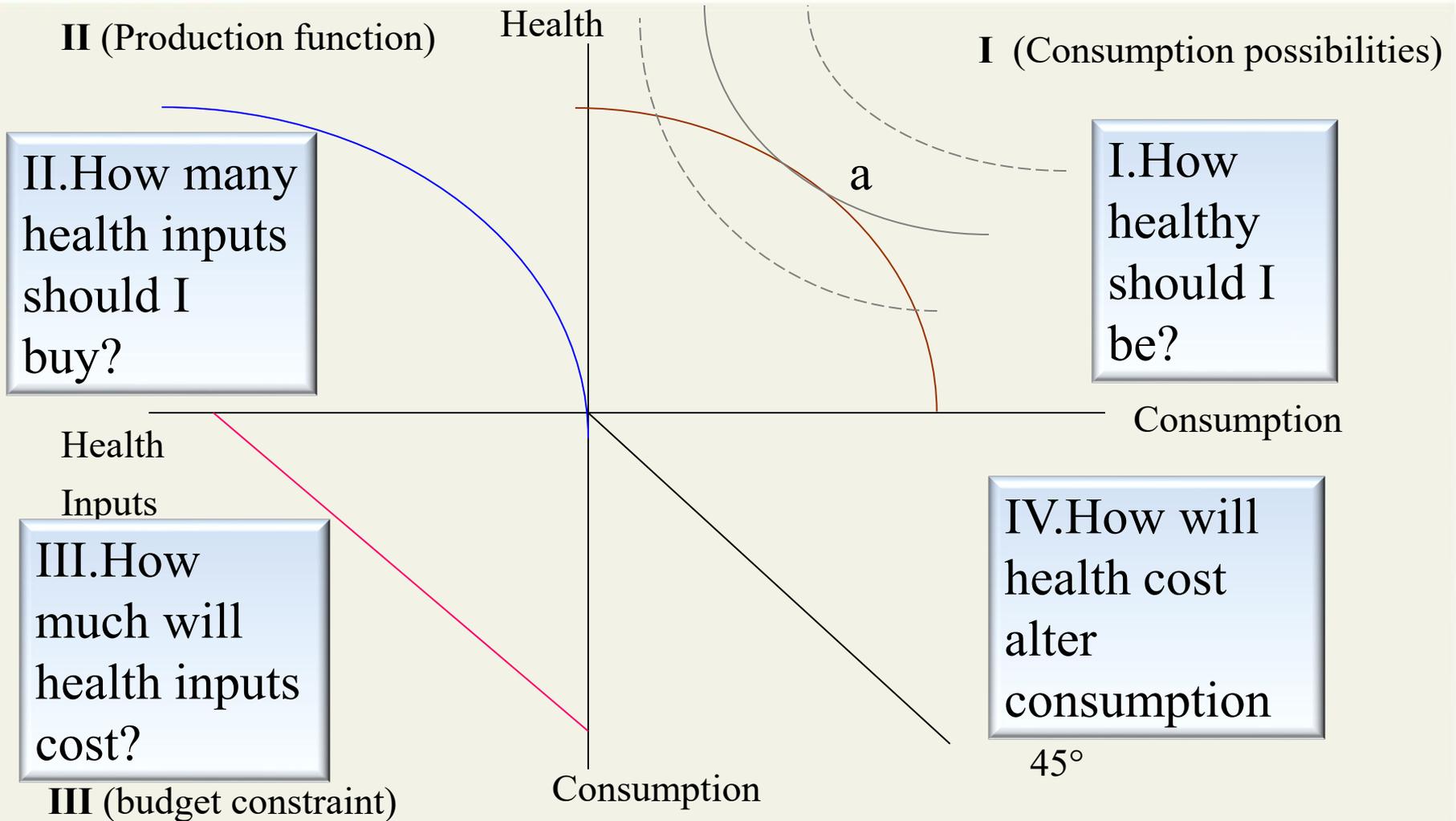


Minutes Exercising

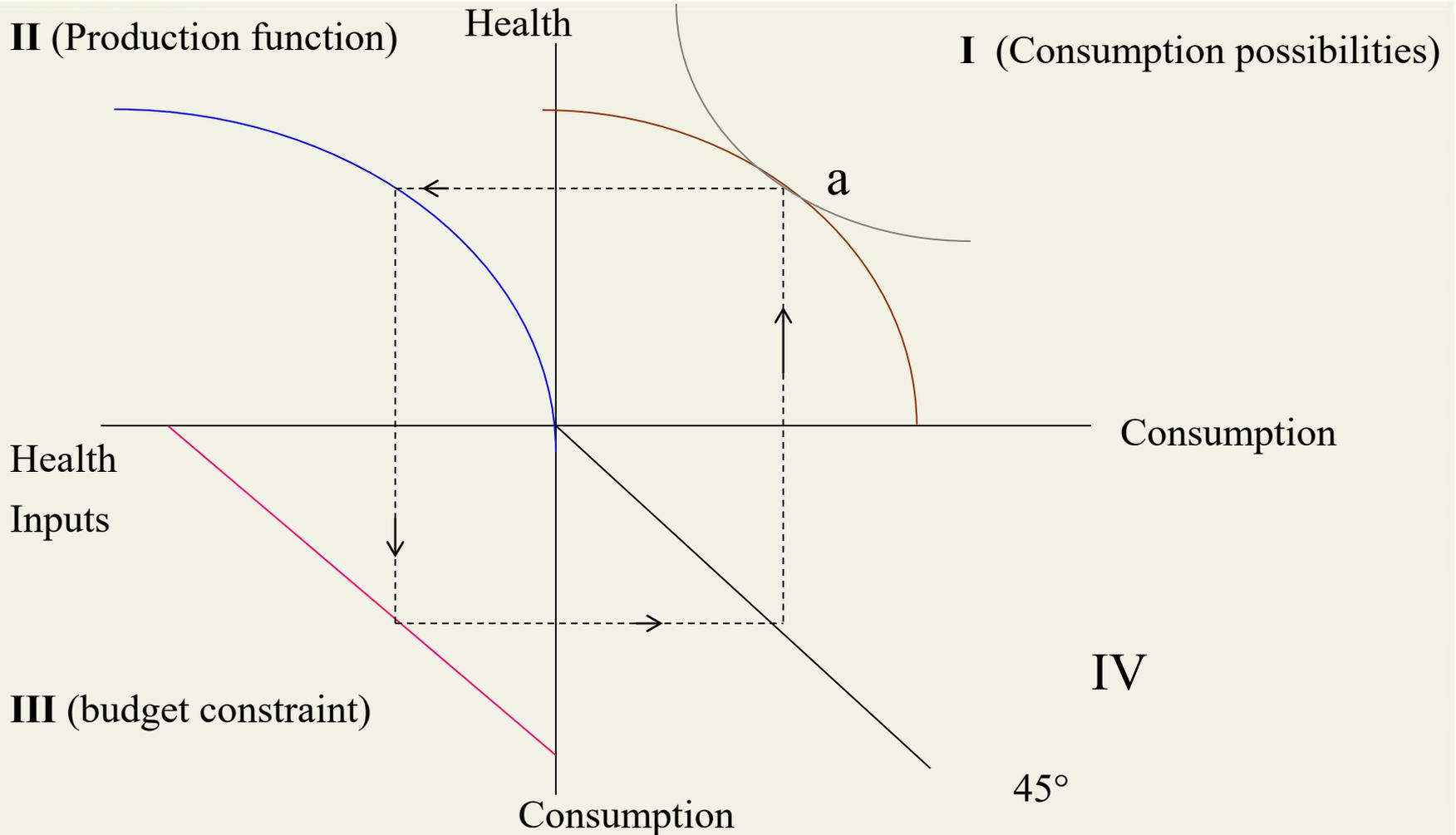
The 4 quadrant diagram



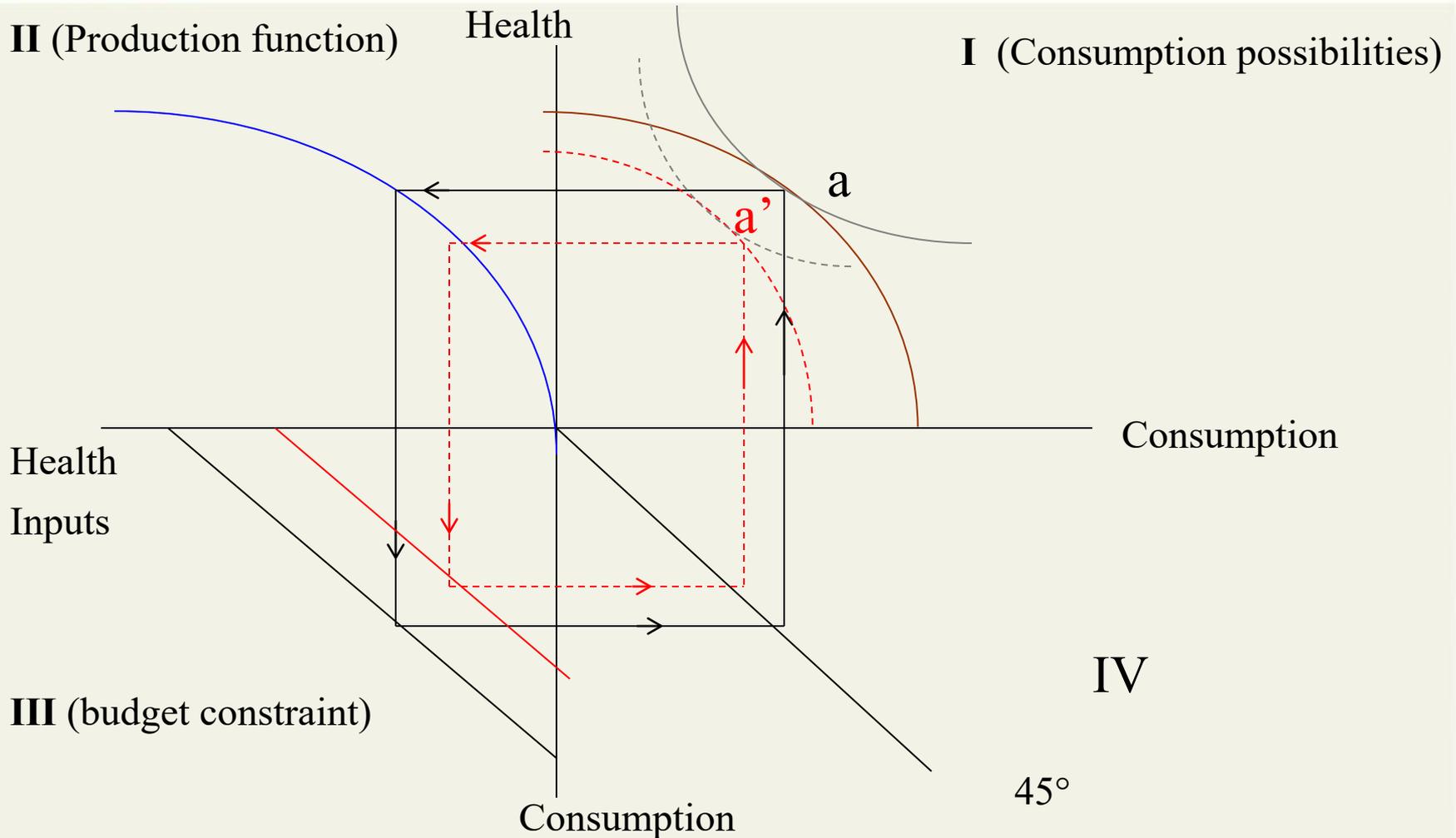
The 4 questions on 4 quadrants



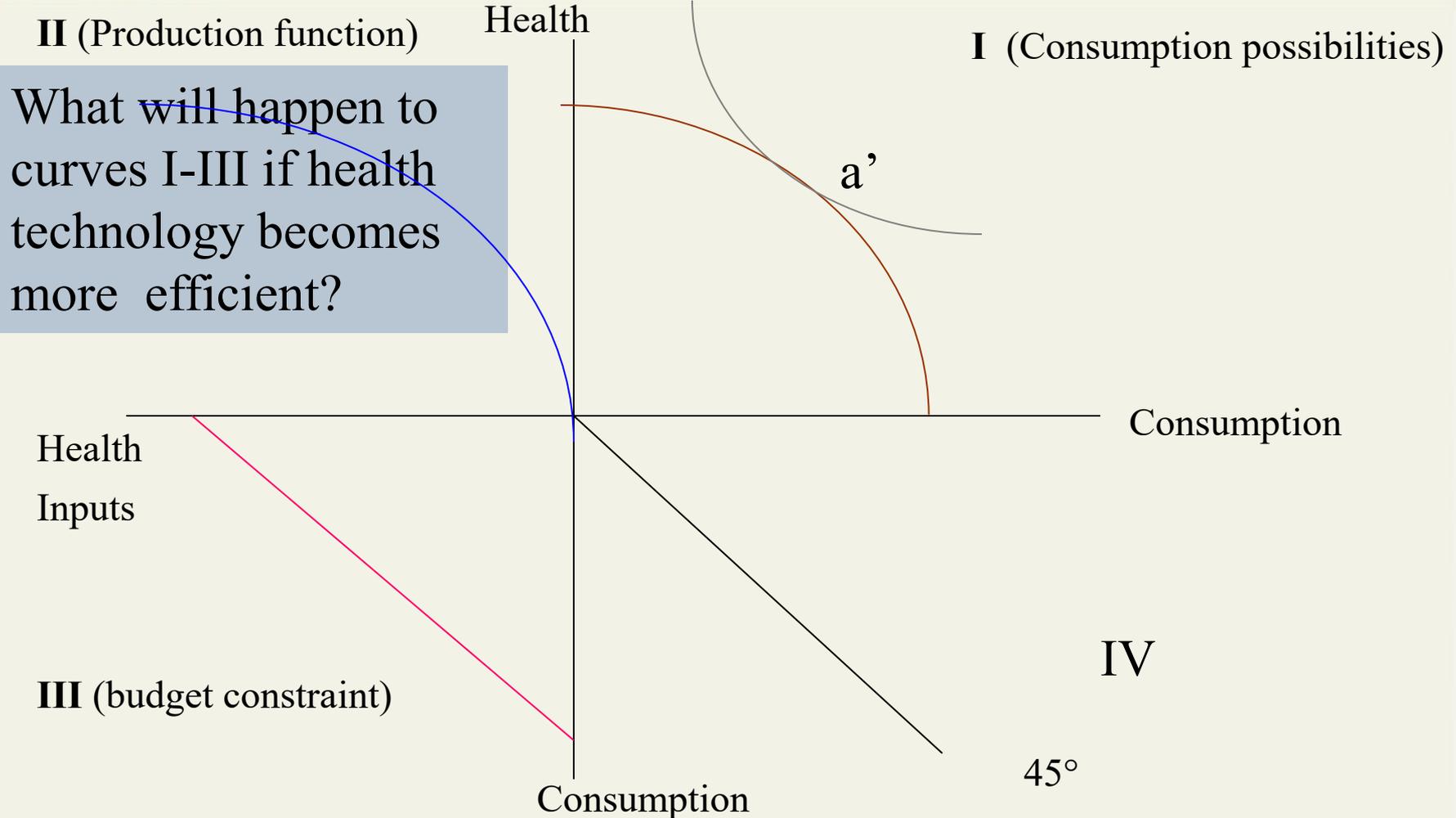
The 4 quadrant diagram



A reduction in income from a to a'



Exercise: improved health technology





Part 2 Marginal Efficiency of Capital



Key assumptions

- Nobody but the individual can produce the individual's health (out of goods+time)
- Individuals value health but do not value it above all else (if they did, they would not over-eat, smoke, drink too much, or drive too fast)
- We have limited incomes with which to finance health and other activities

The value of health

Health can be valued in two ways:

(1) Consumption value:

$$U=U(H, C) \text{ and } Y=P_c C+P_M M \text{ and } H=f(M)$$

- health yields direct benefits i.e. you feel better when you are healthier so you get utility

(2) Investment effects:

$$U(C) \text{ and } (w(H) \times T)=P_c C+P_M M \text{ and } H=f(M)$$

- health increases the wage and the extra stuff you get gives you utility

Health as a capital good

- Let H_t be the stock of health capital for a representative individual at time period t
- H_t is determined by
- $$H_t = H_{t-1} - \delta H_{t-1} + M_t$$
- Where δH_{t-1} is exogenous depreciation
- And M_t is endogenous choice to buy Medical care
- A person is born with initial endowment of H
- The rate of H production will depend on the efficiency of investment in H .

Looking towards the future

- In this model we have multiple periods
- Lets assume that u_t is happiness at time “t” as a function of consumption and health: $u_t = u_t(c_t, H_t)$
- Decisions will be made concerning all future periods, so
- $U_t = U_t [u_t(c_t, H_t), u_{t+1}(c_{t+1}, H_{t+1}), \dots, u_n(c_n, H_n)]$
- There is discounting so
 - Summarize as $U_t = \sum_t \delta^t u(H_t, C_t)$
- $U_t(\)$ will give lower weight to future time periods due to time-preference

The human capital model

- The individual is a producer of H (amongst other things): they buy market goods (medical care, food, clothing), and combine them with their own time to produce services that increase their utility
- Human capital theory predicts that individuals invest in themselves e.g. through training or education, to increase their productivity
- The optimal amount of investment in human capital is determined by the Costs and Benefits:
 - Usually the Costs occur in the short-term
 - Benefits accrue in the future in the form of enhanced income and wellness

The investment decision

- $H_t = (1-\delta)H_{t-1} + f(M_t)$
- Health capital investment depends on conditions
 - $I = f(M | E_1, E_2)$
- Notation: Read $f(A|B)$ to indicate that effect of A is conditioned on B. B shifts the production curve up/down
 - I = investment in health
 - M = market health care inputs
 - E_1 = education;
 - E_2 = environment

Solving the Grossman Problem

- Maximize
- $\sum_t \delta^t U(H_t, C_t)$ such that
$$W_t = P_C C_t + P_M M_t \text{ and } H_t = (1 + \delta)H_{t-1} + f(M_t)$$
- Solution is that Marginal Cost of Investing in Health Capital equals Marginal Benefit of Investing in Health Capital
- It's messy
- It's covered in the reading
- Here is all you need to know
 - $r + \delta = W^*G(H)/C(H)$

What determines healthy choices

Marginal cost (of investing in H) = Marginal benefits

Marginal cost = $r + \delta$,

where

r = rate of interest on other investments

δ = rate of depreciation of health

Marginal benefit = $\frac{(W \times G(H))}{C(H)}$

where

W = wage rate,

$G(H)$ = marginal product of health investment

$C(H)$ = direct cost of investment in health

Intuition

- STOCK PORTFOLIO

- Suppose invested in Google and Apple
- Decision: Should you sell shares of Google and buy shares of Apple?
- Marginal Cost—lost rate of return on Google
- Marginal Benefit—gained rate of return on Apple

- HEALTH

- Marginal cost=ratio of dividends to investment r
PLUS new asset depreciates
 - $= r + \delta$
- Marginal benefit=ratio of better wages to the cost paid for the extra health
 - $= W * G / C$

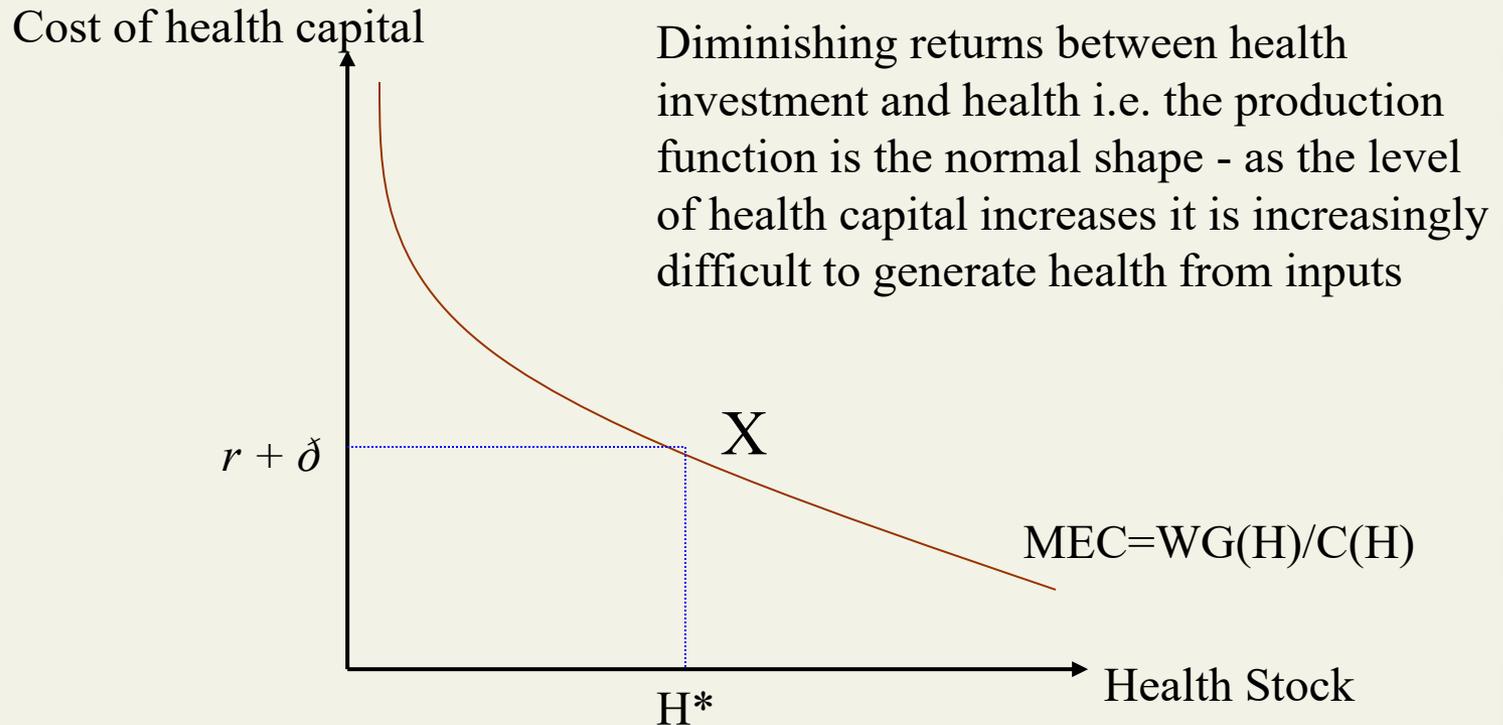
Marginal Efficiency of Health Capital

- MEC is

$$\frac{W \times G(H)}{C(H)}$$

- $G(H)$ gets smaller as H increases
- $C(H)$ could get smaller or bigger
 - Health capital could be reduced by a cheap curable condition
 - Health capital could be reduced by an expensive chronic
- $C(H)$ definitely gets bigger with AGE

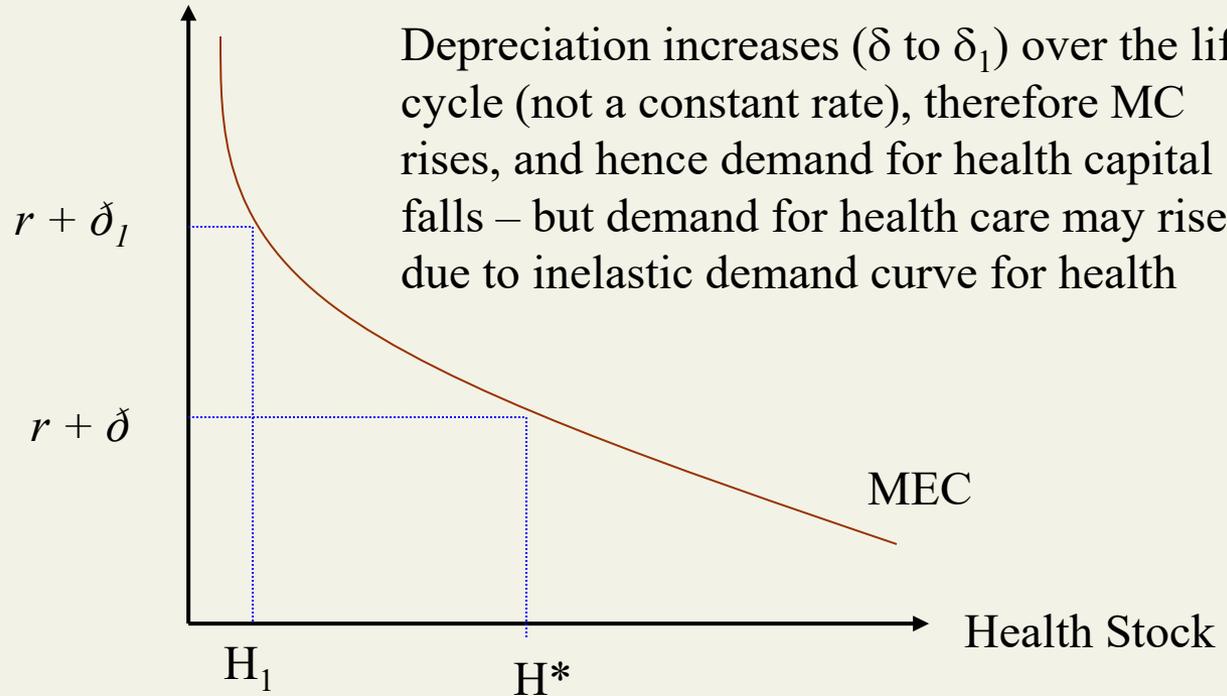
Demand for Health Capital



At point X marginal cost = marginal benefit

The Effect of Ageing: Increase δ

Cost of capital



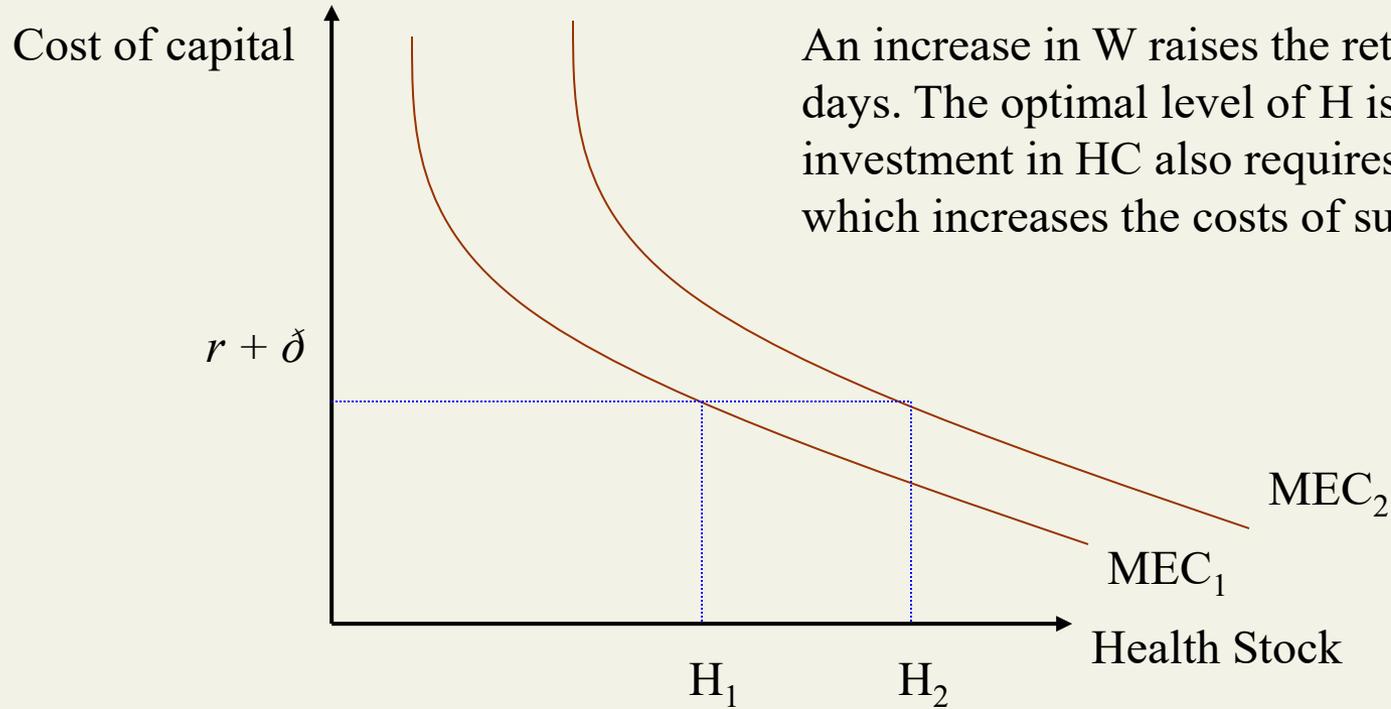
Part of this is offset by increasing investment in H so health care demand rises.



Endogenous length of life

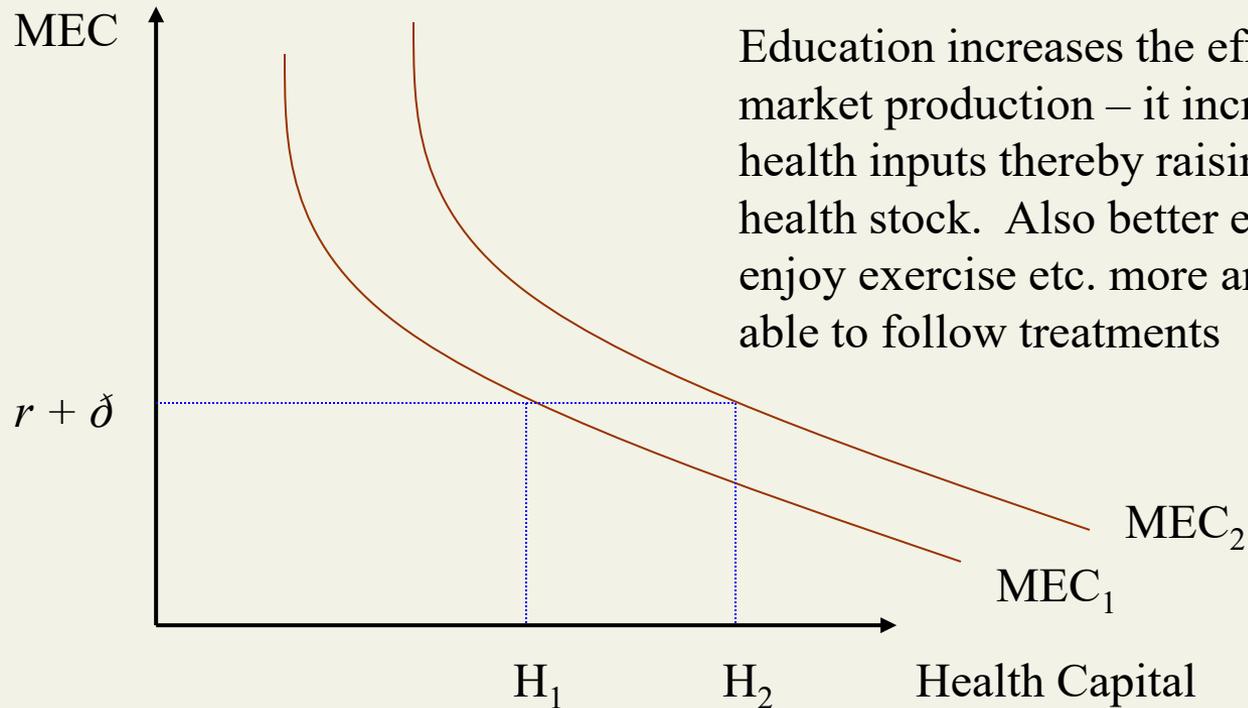
- “Biological factors associated with ageing raise the price of human capital and cause individuals to substitute away from future health until death is chosen” (Grossman, 1972)

Changes in the Wage Rate



An increase in W raises the returns on healthy days. The optimal level of H is thus higher. But investment in HC also requires an input of time which increases the costs of such investment.

Changes in Education



Education increases the efficiency of non-market production – it increases the MP of health inputs thereby raising the optimal health stock. Also better educated may enjoy exercise etc. more and may be more able to follow treatments

Education enhances health capital

- Education plays a crucial role in determining the efficiency of health capital and also in other production functions, therefore influences consumption patterns of households
- Education makes workers on the shop floor use better judgement in factory production
- Grossman hypotheses
 - 1) Education makes all people use better judgement in choosing health creating inputs and environments
 - 2) Education makes people have time preference that places more weight on the future

Change in prices

- A fall in the price of a unit of health inputs results in the budget line swivelling outwards from the intercept on the consumption axis
- Assuming that the individual did not devote all of her income to consumption before the price change, she will employ more health inputs and consequently will be achieve better health.
- This suggests that subsidising the price of health inputs (for example, milk and heating) will result in improved health for those receiving such subsidies.



Technical knowledge/education

- Advances in medical science or education will cause an upward shift in the health production function
- This means that the individual can reach a higher level of health for the same level of health inputs
- This suggests that a health education programme may bring about improved health without any increase in the demand placed on health services and other health inputs

Application to choice behaviour

- If other capital stocks are low an individual will choose to deplete her health stocks in order to replenish other stocks
- A high wage occupation that causes the stock of health to decline may be chosen if the stock of wealth is low
 - “Burn the candle at one end”
- A similar kind of argument might be applied to the type of recreation activities which are chosen
 - “Being a fool for love”

Policy implications

- The model can be used to predict the likely (and opposite than intended) effects of policy changes
 - The government may offer extended clinic hours in order to encourage greater utilisation of health care by the poor
 - This will increase the MEC of both rich and poor but since the value of extra time (W) is greater for the rich, the MEC will shift up more for richer people, and the inequality will worsen

Criticisms of the model

- It ignores public health policy
- Assumes health care is a constant life time investment
- It ignores insurance markets
- Assumes perfect information on the part of consumers about the MEC of health care, interest rates, depreciation, etc. – for now and the future.
- It is deterministic including the choice of when to die!

Summary of Grossman Model

- Consumers want health not health care *per se*
- Consumers produce health
- Health does not depreciate instantly
- Demand for health has pure consumption and pure investment aspects
- The cost of holding health capital is the opportunity cost of capital (r) plus the depreciation rate (δ)
- The MEC curve is downward sloping because of diminishing benefits of health capital
- Rewards of being healthy are greater for high wage people



Important questions

- Why does better education of individuals mean that they will be healthier?
- What is the link between poverty and health?
- What effect do wages have on health?
- Can we affect the rate of depreciation?
- Can we affect the rate of time preferences?

The Future of the Grossman model

$$H_t = (1 + \delta)H_{t-1} + f(M_t, PH_t)$$

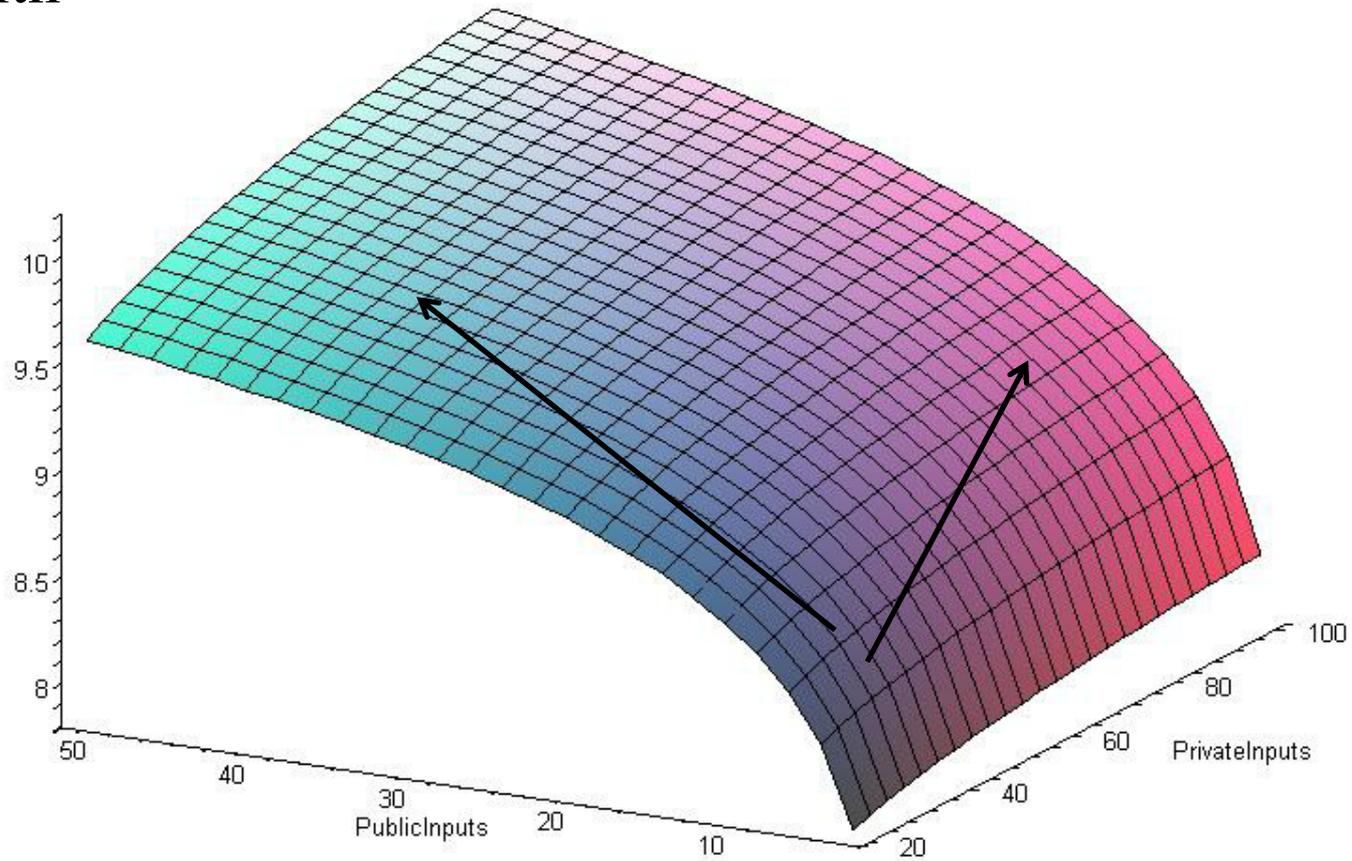
Where PH is Public Health Capital

PH is a partial substitute for M



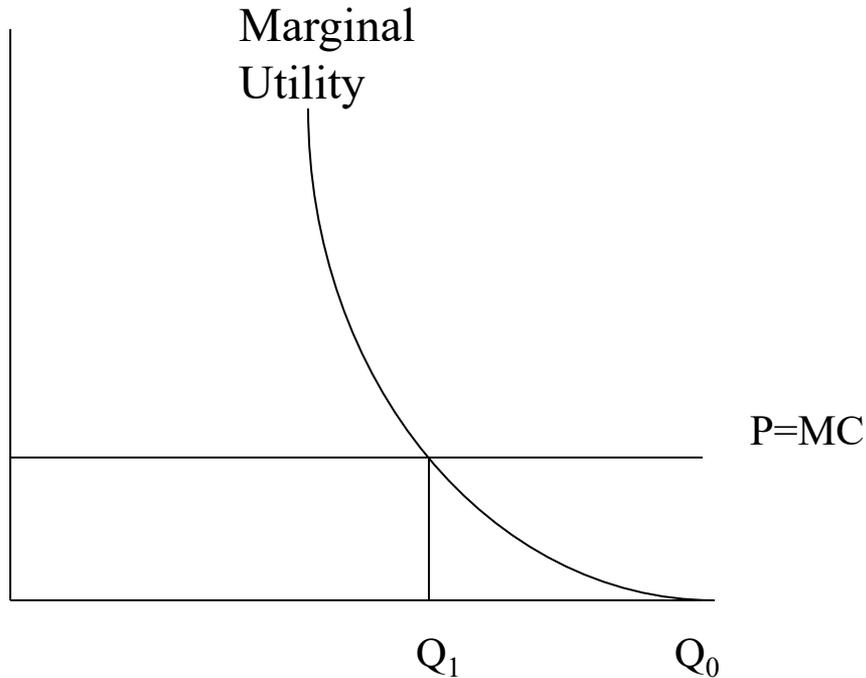
Two ways up the health mountain

Health



Implications of Grossman Maximizing

Lohr's Theory



Rational Consumer

If fully insured then consume Q_0

If uninsured then consume Q_1

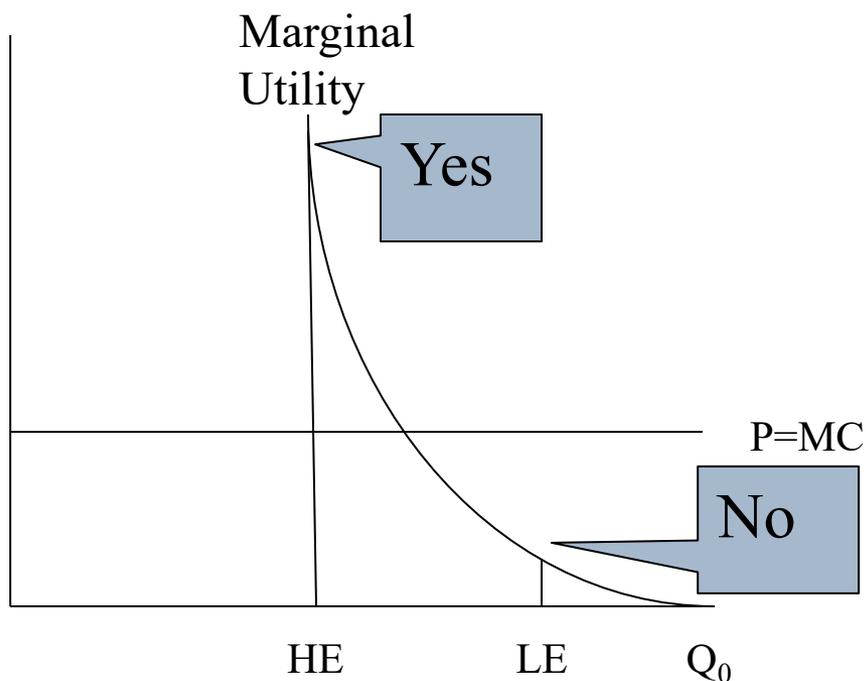
AND

The Bundle in Q_1 is More Highly Effective Health Care than the Bundle in Q_0



Withdrawing insurance creates efficiency

Lohr's Theory



Two kinds of health care

Highly Effective (HE)

Only need a few of these services to get high benefit

Low Effectiveness (LE)

Need to buy lots of these and still low benefit

Grossman Maximizer

Won't buy LE because Marginal Utility is lower than Marginal Cost

Will buy HE because Marginal Utility is higher than Marginal Cost



Is a HealthCare Demand Curve REALLY a Marginal Utility Curve?

Thought experiment—Demand for Fruit

Suppose you lived in a world with only two kinds of fruit

Tangerines

Lemons

They cost exactly the same price per pound

You hate lemons but you can use them for compost



Thought Experiment: What mix of lemons and tangerines would you eat if fruit cost “C*P”?

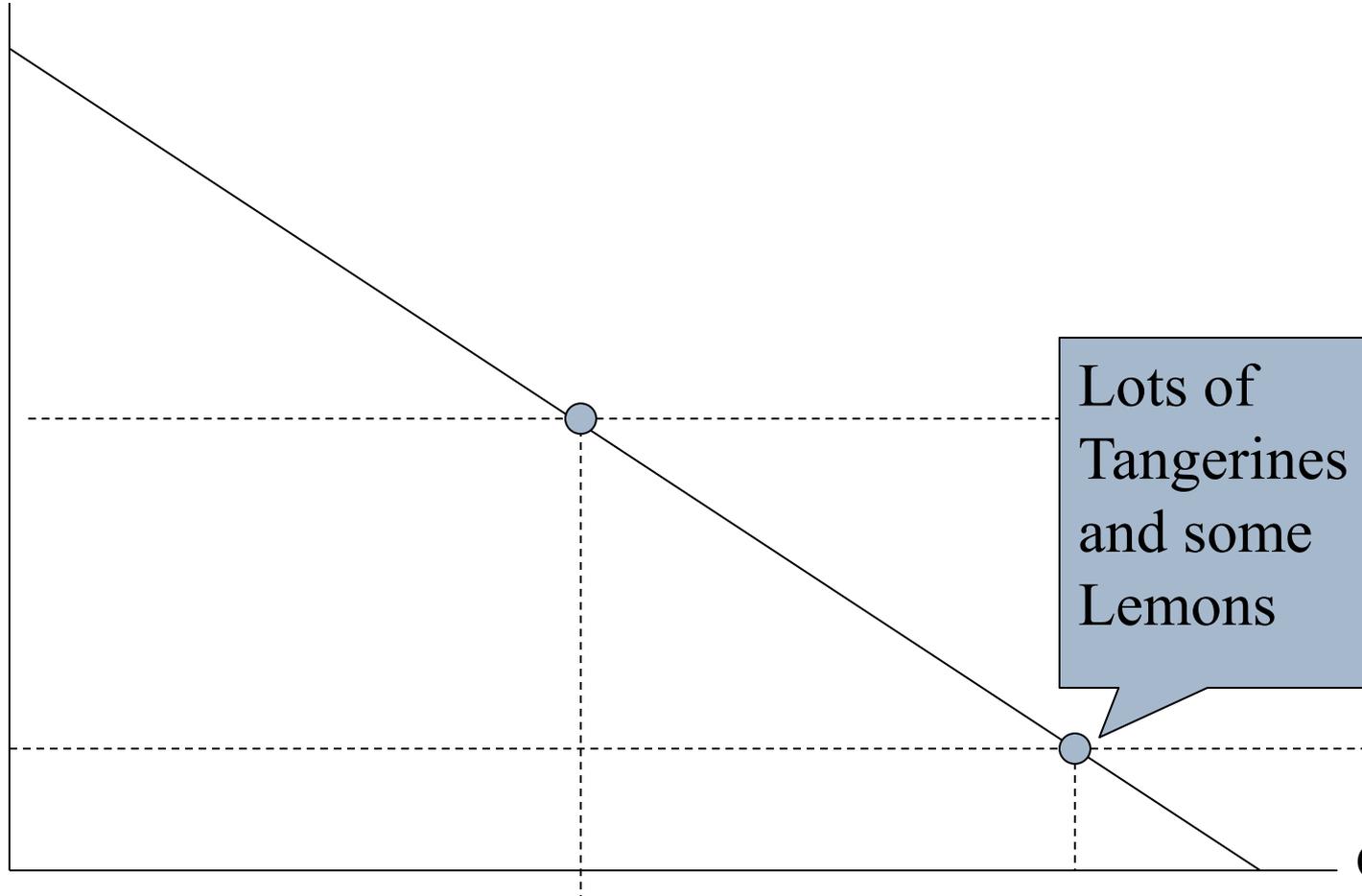
Price of “Fruit”

P=
Marginal
Cost

C*P

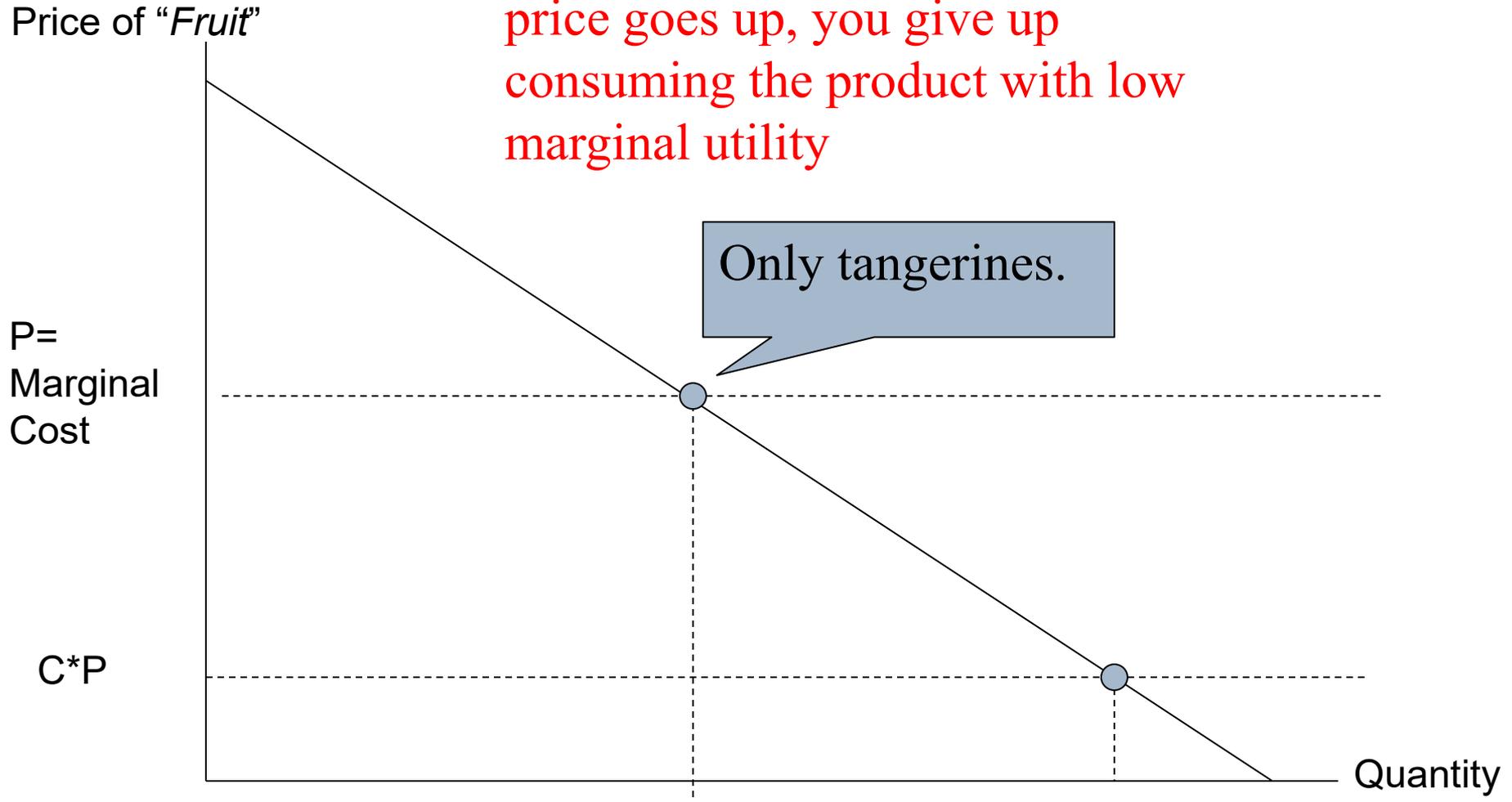
Lots of
Tangerines
and some
Lemons

Quantity



What if the price went back up to marginal cost?

If D is a marginal utility curve and price goes up, you give up consuming the product with low marginal utility



Is a HealthCare Demand Curve REALLY a Marginal Utility Curve?

Now lets do Health Care

Suppose you lived in a world with only two kinds of health care

- High value (life saving) health care

- Low value (optional) health care

They cost exactly the same price per encounter



Lohr's Experiment: What mix of high value and low value health care?

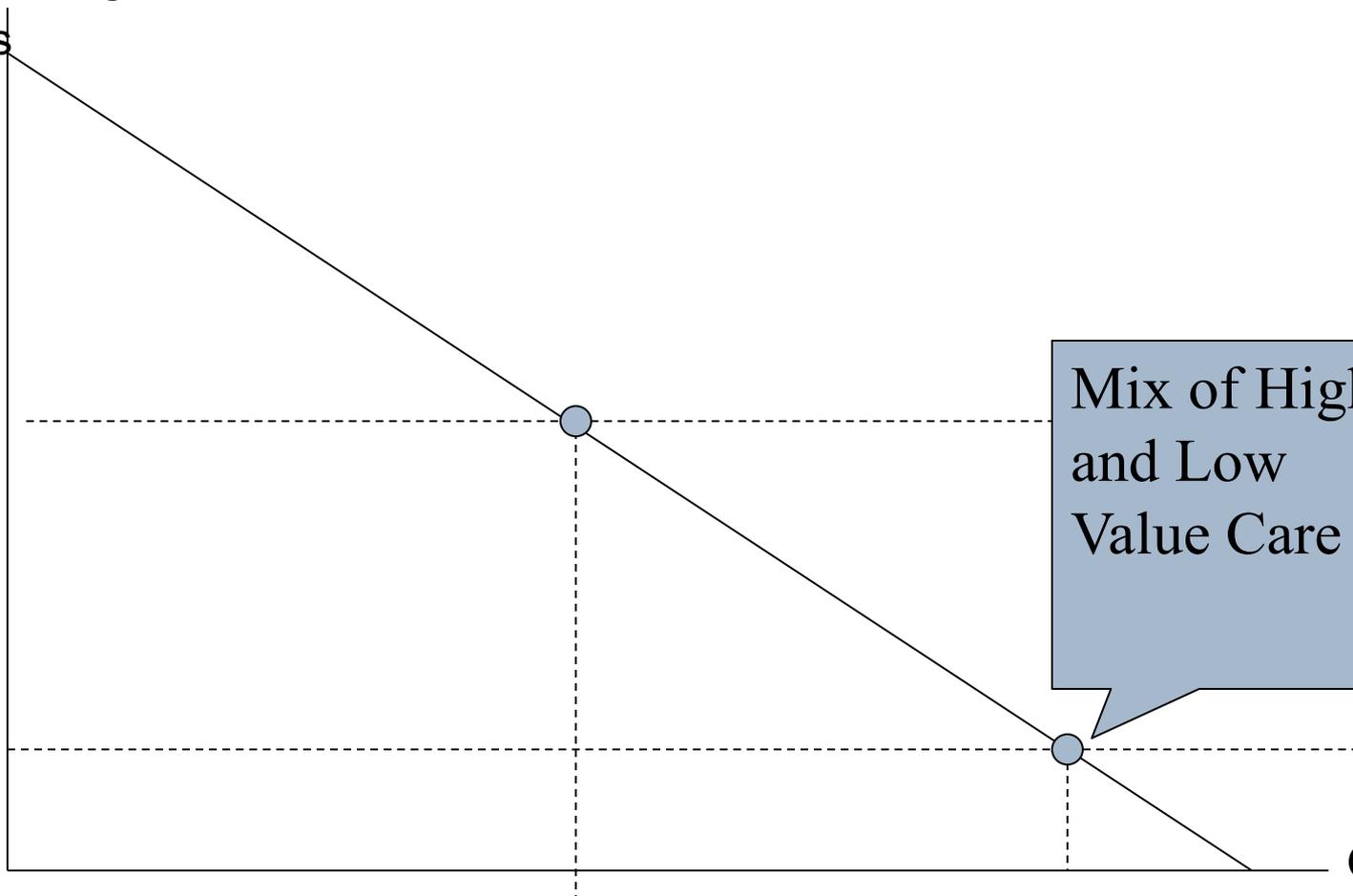
Price of Health Care Encounters

$P =$
Marginal Cost

C^*P

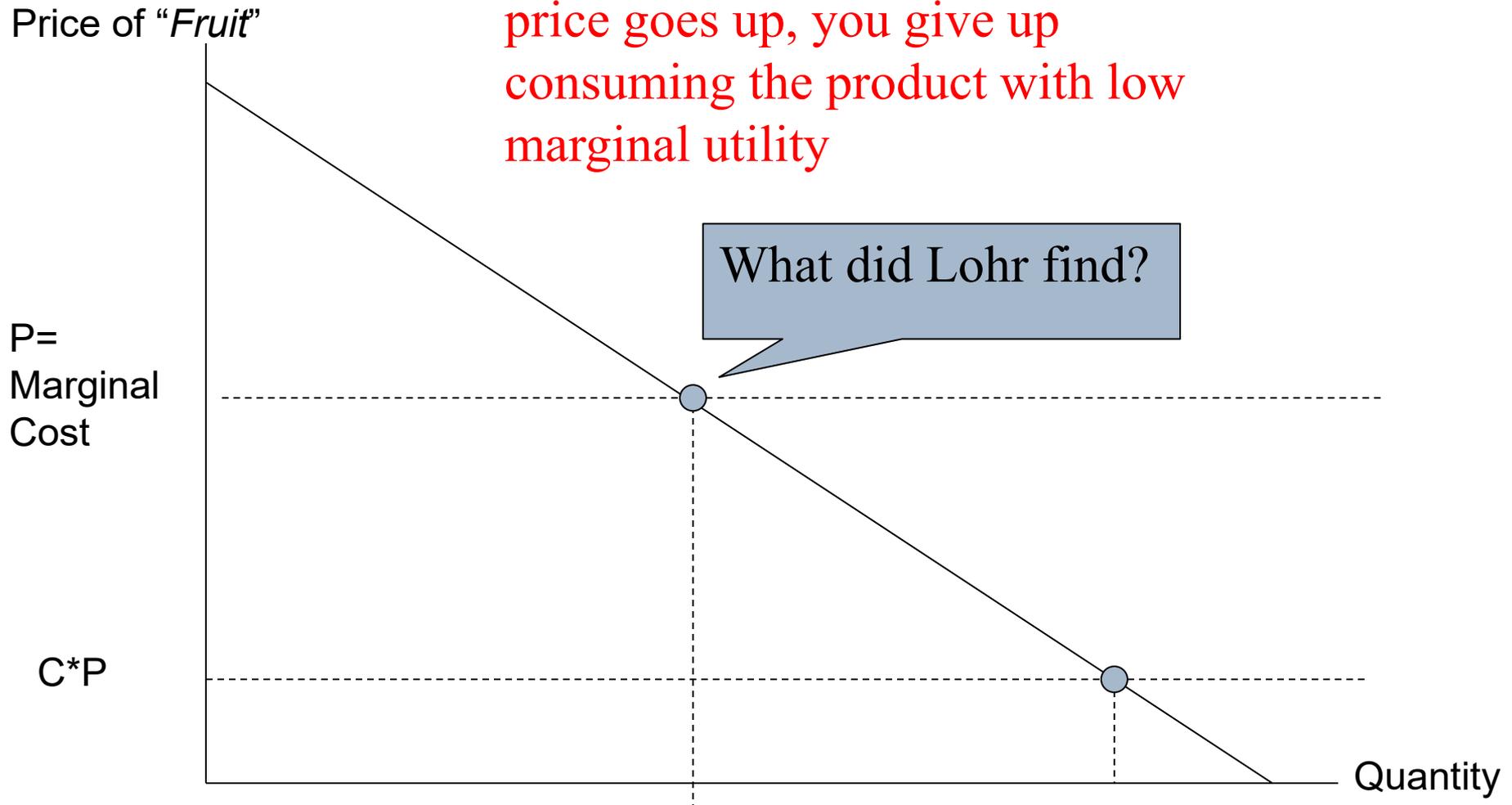
Mix of High and Low Value Care

Quantity



What if the price went back up to marginal cost?

If D is a marginal utility curve and price goes up, you give up consuming the product with low marginal utility



Lohr's Finding

As Coinsurance went up in the Rand Experiment

People gave up both high value and low value services equally.

This is not compatible with interpreting the demand curve as a marginal utility curve.

Problems

Lohr's definitions of high value/low value were criticized

People did not have WebMD back then



Evidence from Rand HIE

Utilization

Children in upper middle income groups assigned to coinsurance used 85% as much highly effective care as free plans.

Reduced care the same for LE and HE

Health

Summary measures of health (SF30) unaffected

Free care had

1.4 mm better control of BP

better vision correction if 20/25



Who cares?

If health care demand curves are marginal utility curves

Deadweight loss is real

Coinsurance helps control a real problem

If health care demand curves are just a “loose correspondence between price and quantity”

Deadweight loss is suspect

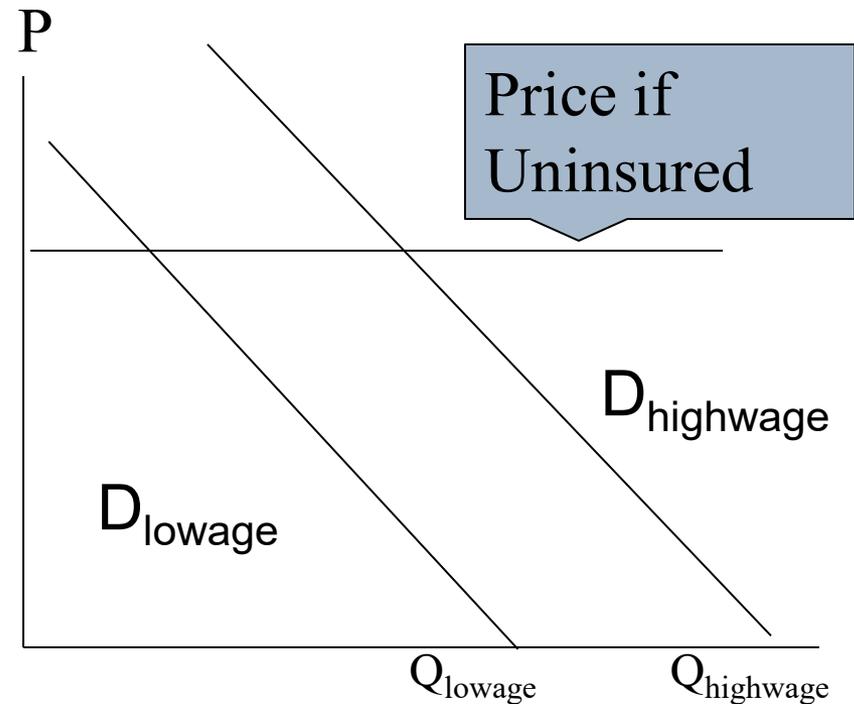
Coinsurance can hurt people who give up life saving treatment because they don't know better



Grossman Implications on Health Equity

- Grossman's theory implies that schooling and wages are fundamental reasons why demand for health is low
- Implies that there will *always* be differences in health related to differences in wage and schooling
 - Limit to how much policies can fix inequalities between rich and poor.

$P=0$ if insured



Summary Demand for Health

Grossman model

We demand health to

A) Get more money out of the labor market

B) Get utility from health

Grossman model predicts

A) Schooling will make people want more health and more health care

B) Low wage people have lower demand for health

C) Insurance leads to demand for low value care

