DEMAND FOR AND SUPPLY OF HEALTH CARE

EE 474 Health Economics

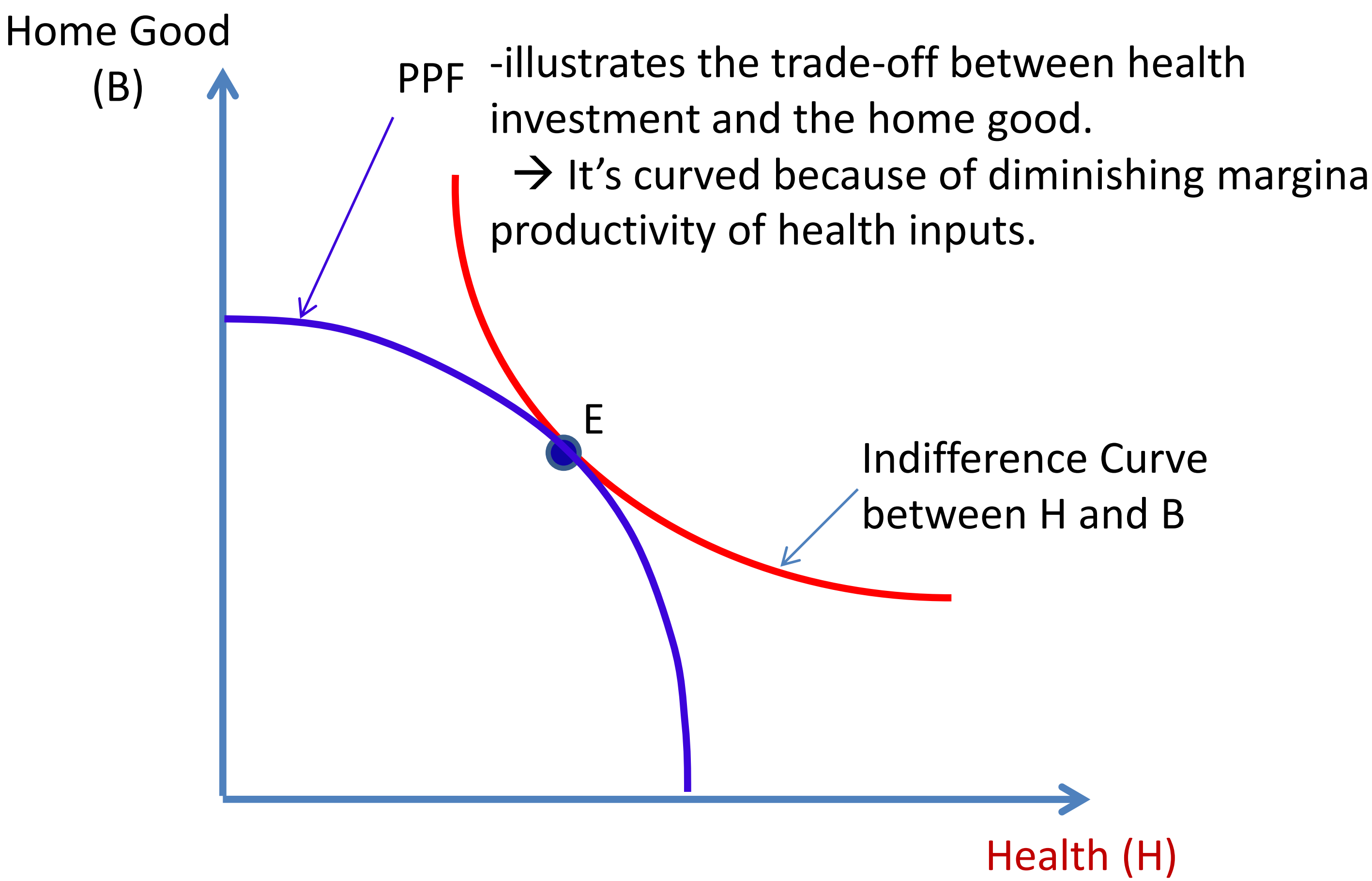
Semester 2/2021

DEMAND FOR HEALTH CARE

Topics

- Demand for Health Capital (Revisited)
- Demand for Health and Health Care
- Demand for Health Care in the Standard Budget Constraint Model
- Comparative Statics
- Empirical Studies
- Other Variables Affecting Demand

Recall: Demand for Health Capital



-illustrates the trade-off between health investment and the home good.

→ It's curved because of diminishing marginal productivity of health inputs.

Switching from Health Capital (H) to Medical Care (M)

- Now, we want to derive *the demand for medical care.*
  - We've shown that $H=f(M)$, so the demand for M is derived from the demand for H.
- Consider the utility as a function of other good (Y) and medical care (M), rather than health (H): $U = U(Y, M)$
- Assume that M is homogeneous and represents the number of units of medical care.
- The budget line is a straight line because each unit of M costs the same number of dollars and means the same reduction in Y.
  - The slope of the budget constraint is constant.

Consumer's Maximization Problem

- The consumer's problem now is:

  Maximize $U = U(Y,M)$

  subject to $I = P_M * M + P_Y * Y$,

  where I = total income,

  P_M = Medical care price per unit

  P_Y = Price per unit of other goods

- Let $P_Y = 1$. So, the budget can be simplified to
  - I =

Standard Budget Constraint Model

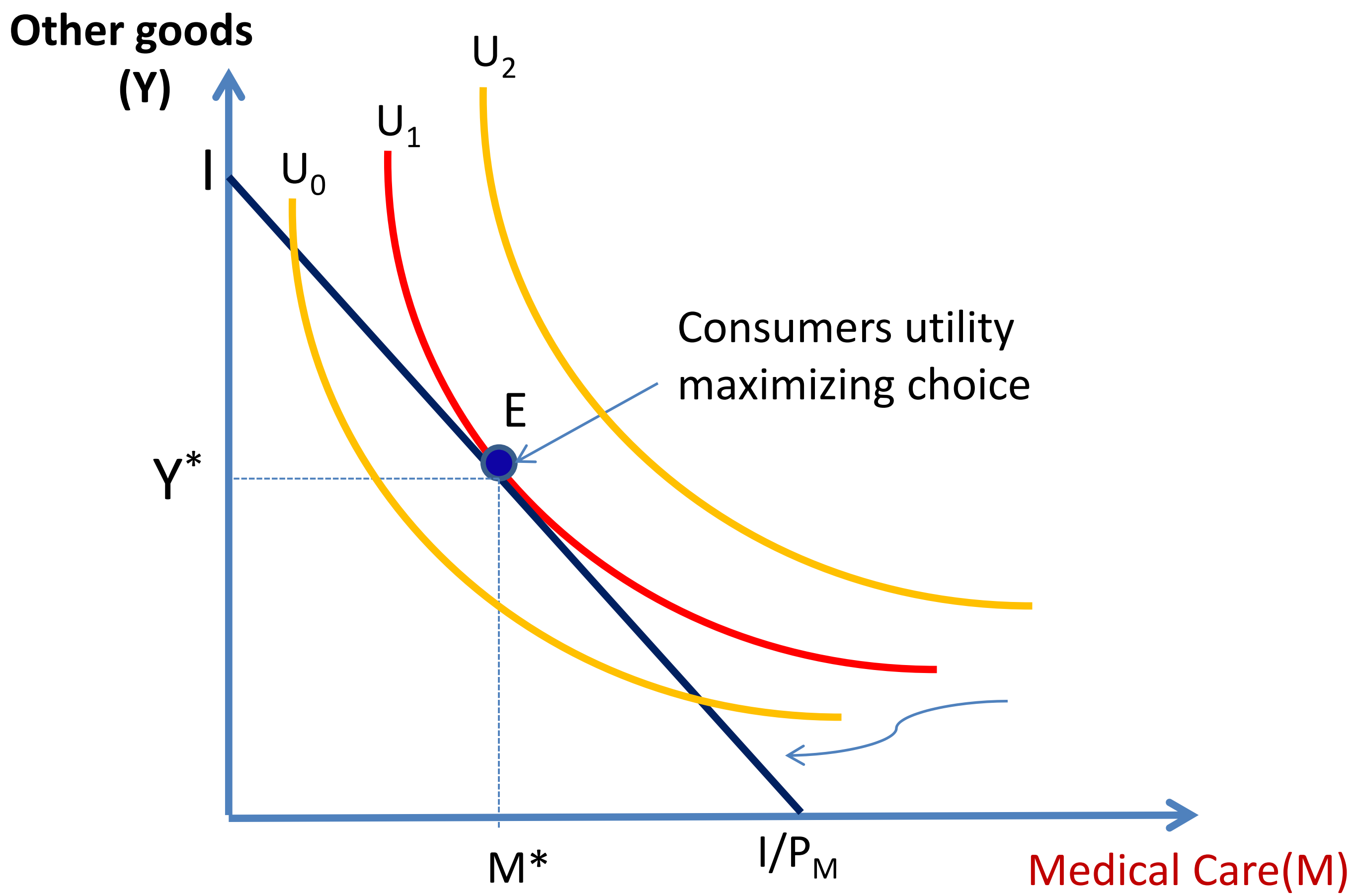
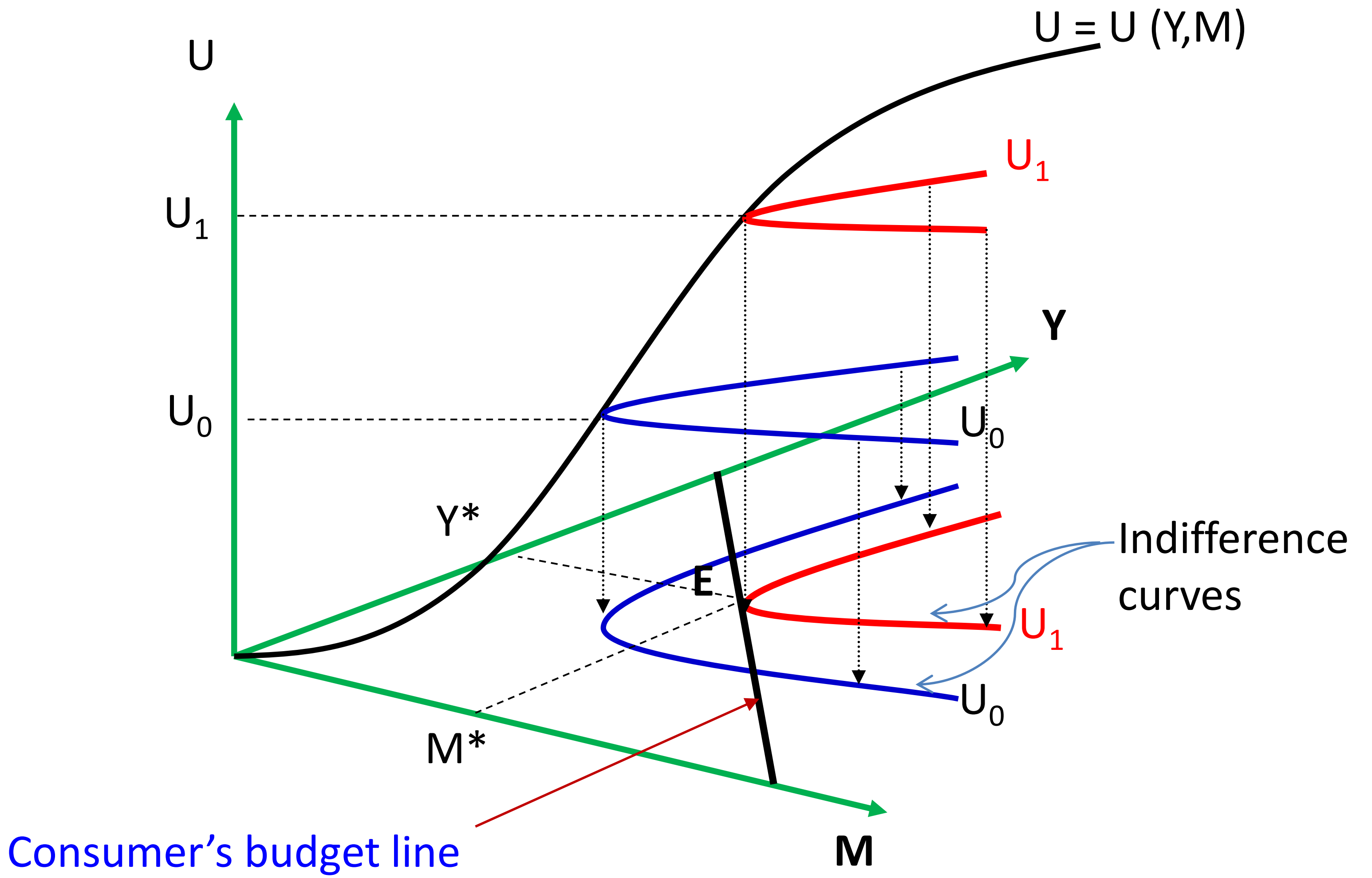


Illustration of U = U (Y, M) in a 3-space diagram.



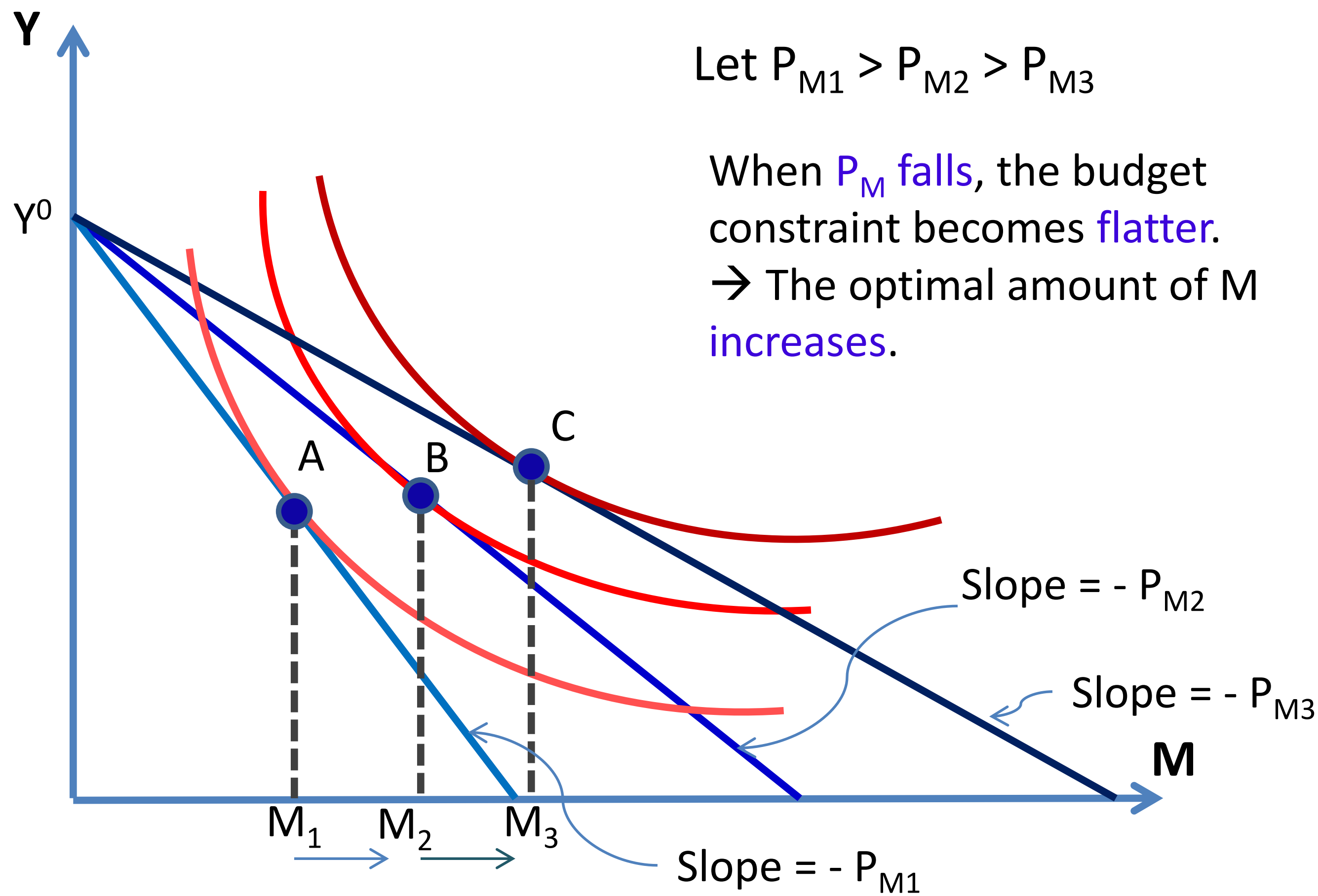
Utility Maximization

- At point E the slope of indifference curve U_1 (marginal rate of substitution) is just equal to the price ratio:

$$\boxed{MRS_{MY} = \frac{MU_M}{MU_Y} = P_M}$$

- The marginal rate of substitution (MRS) is a measure of the rate at which a consumer is *willing* to trade other goods for medical care.
- The price ratio is a measure of the rate at which a consumer *can* trade other goods for medical care.

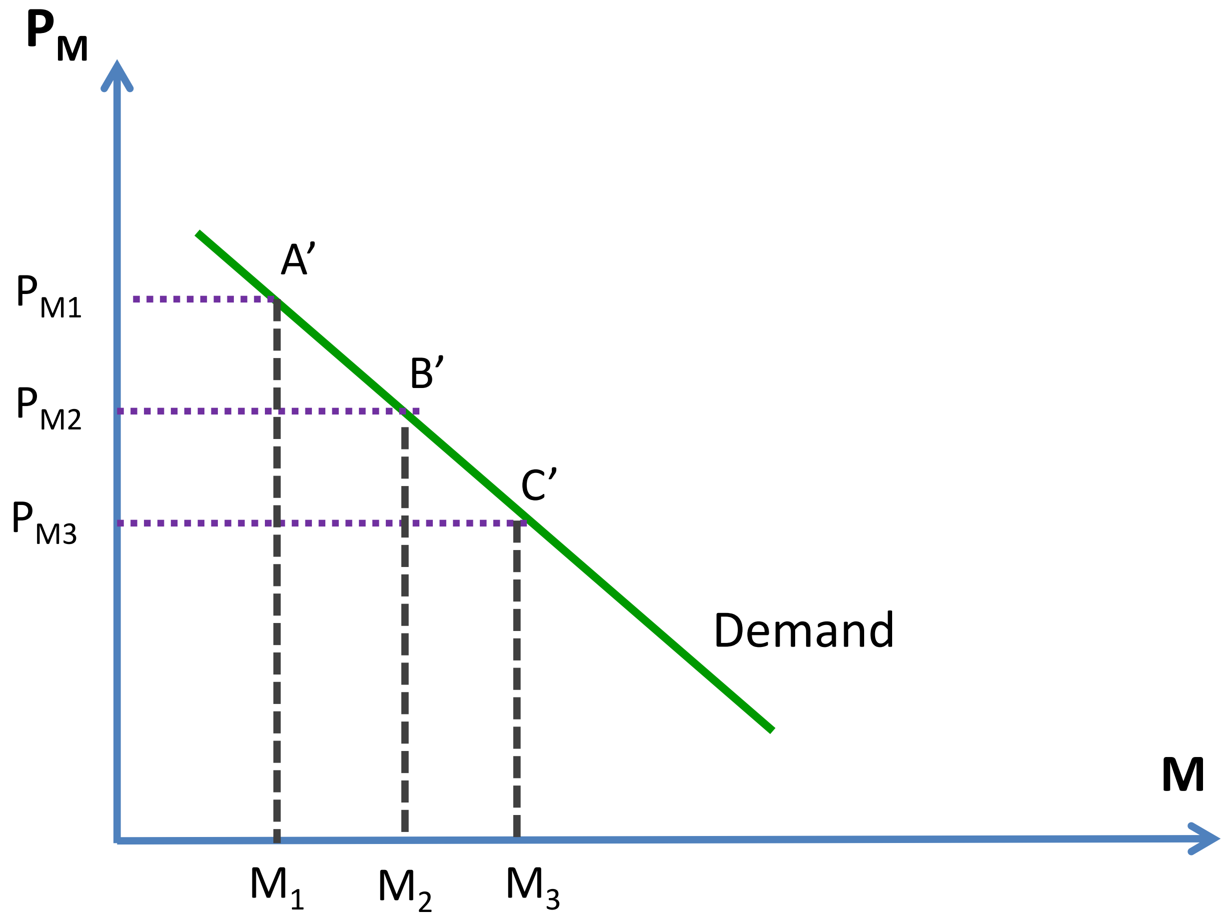
What Happens when P_M Falls?



Let $P_{M1} > P_{M2} > P_{M3}$

When P_M falls, the budget constraint becomes flatter.
→ The optimal amount of M increases.

The Demand for Medical Care



Comparative Statics

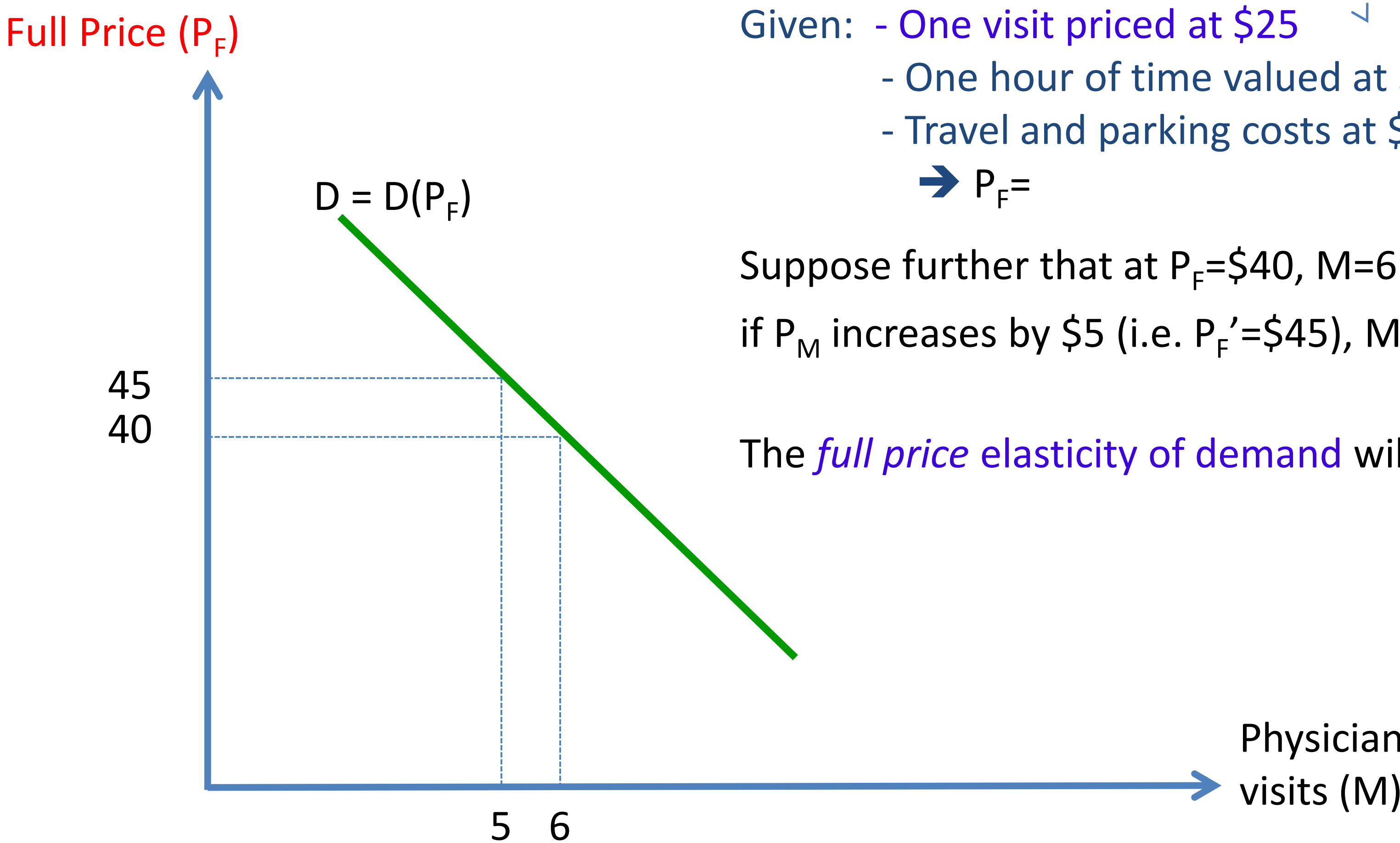
- Comparative statics is a type of analysis where the original equilibrium is identified, and *after a change occurs*, the new equilibrium is compared to the old one.
- We will consider how the following changes affect the demand for medical care.
  - Change in health status
  - A decrease in medical care price
  - An increase in income
  - An increase in the price of a substitute (or complement)
  - Two other factors that affect demand for medical care:
    - Time cost
    - Coinsurance

Role of Time

- Suppose the medical care is physician visits.
- The total cost of a physician visit might include both the money price of the visit itself and the cost of being away from work and not getting paid:
  - **$P_F = P_M + P_T = P_M + wT$,**

  Where P_F= Full price, P_M = Money price, P_T =Time price, w = wage rate, and T is time spent in obtaining care.
- So, the longer the time (T) involved in traveling, waiting, and receiving services, the higher the total price of medical care, and the smaller the quantity demanded.
- Similarly for higher wages (w)

Example: Demand and Time Price for Physician Visits



Given: - One visit priced at $25

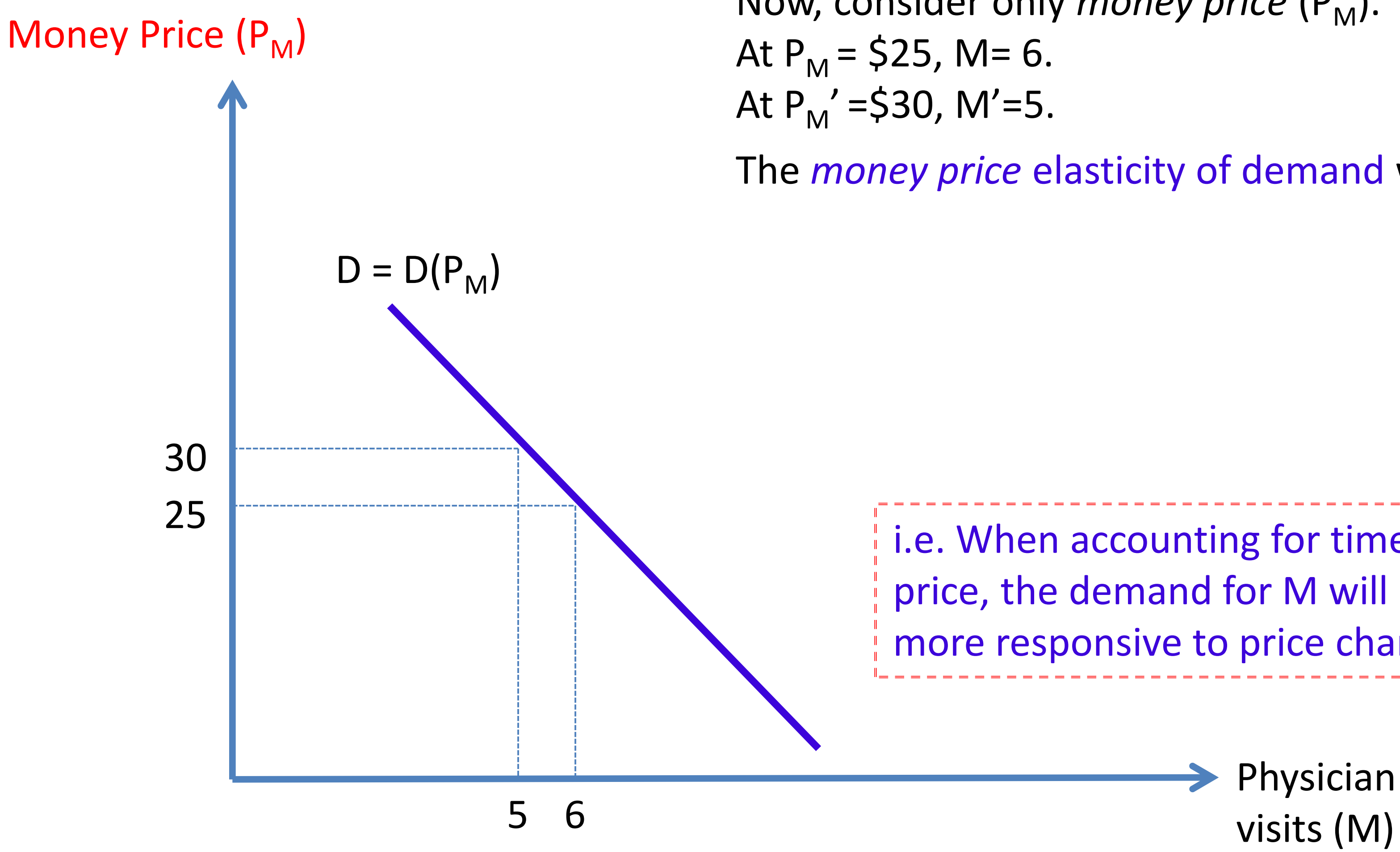
- One hour of time valued at $10
- Travel and parking costs at $5

➔ P_F=

Suppose further that at P_F=$40, M=6 and if P_M increases by $5 (i.e. P_F'=$45), M'=5.

The *full price* elasticity of demand will be:

Example: Demand and Time Price for Physician Visits (cont'd)



Now, consider only *money price* (P_M).
At P_M = \$25, M= 6.
At P_M' =\$30, M'=5.

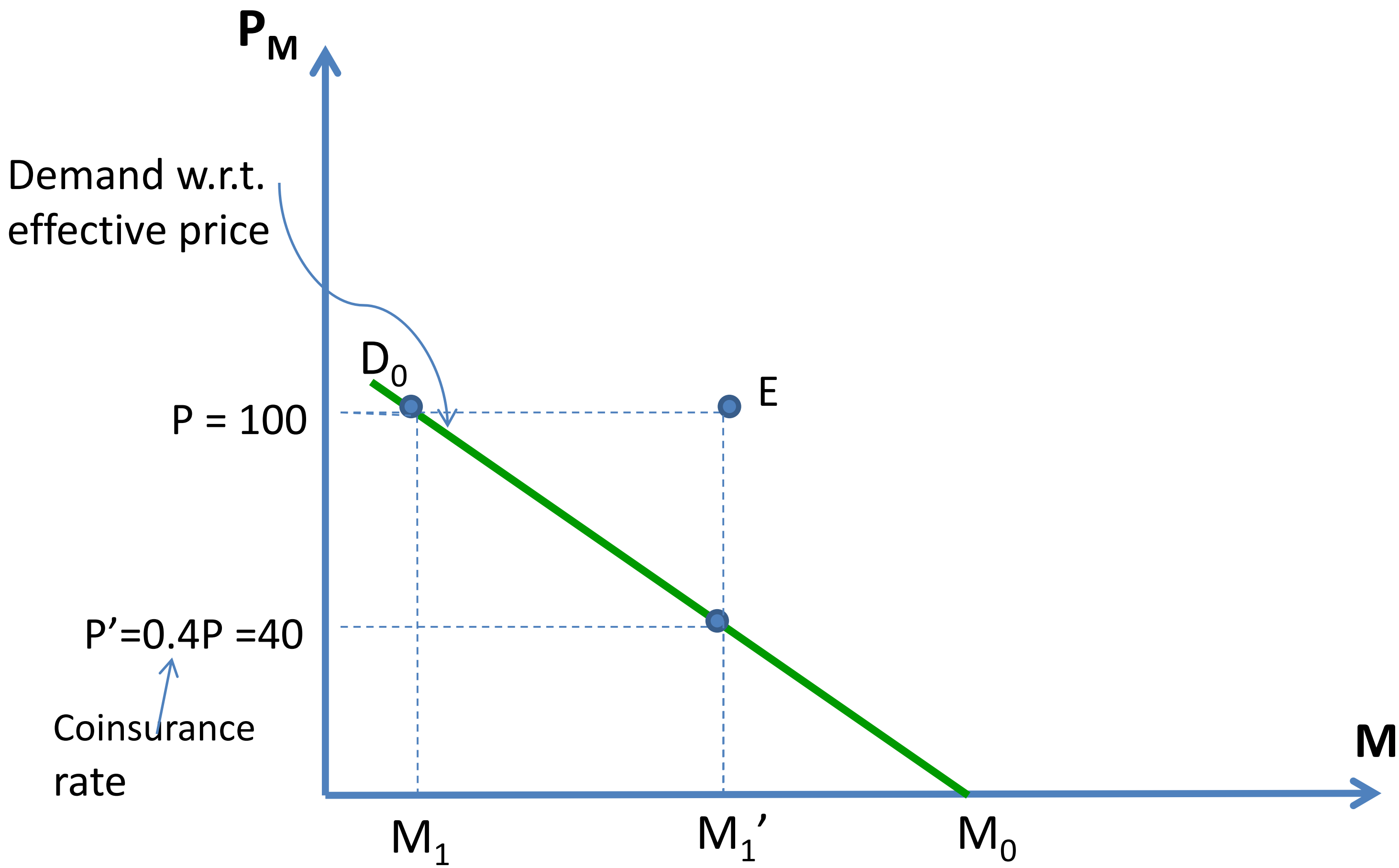
The *money price* elasticity of demand will be:

i.e. When accounting for time price, the demand for M will be more responsive to price change.

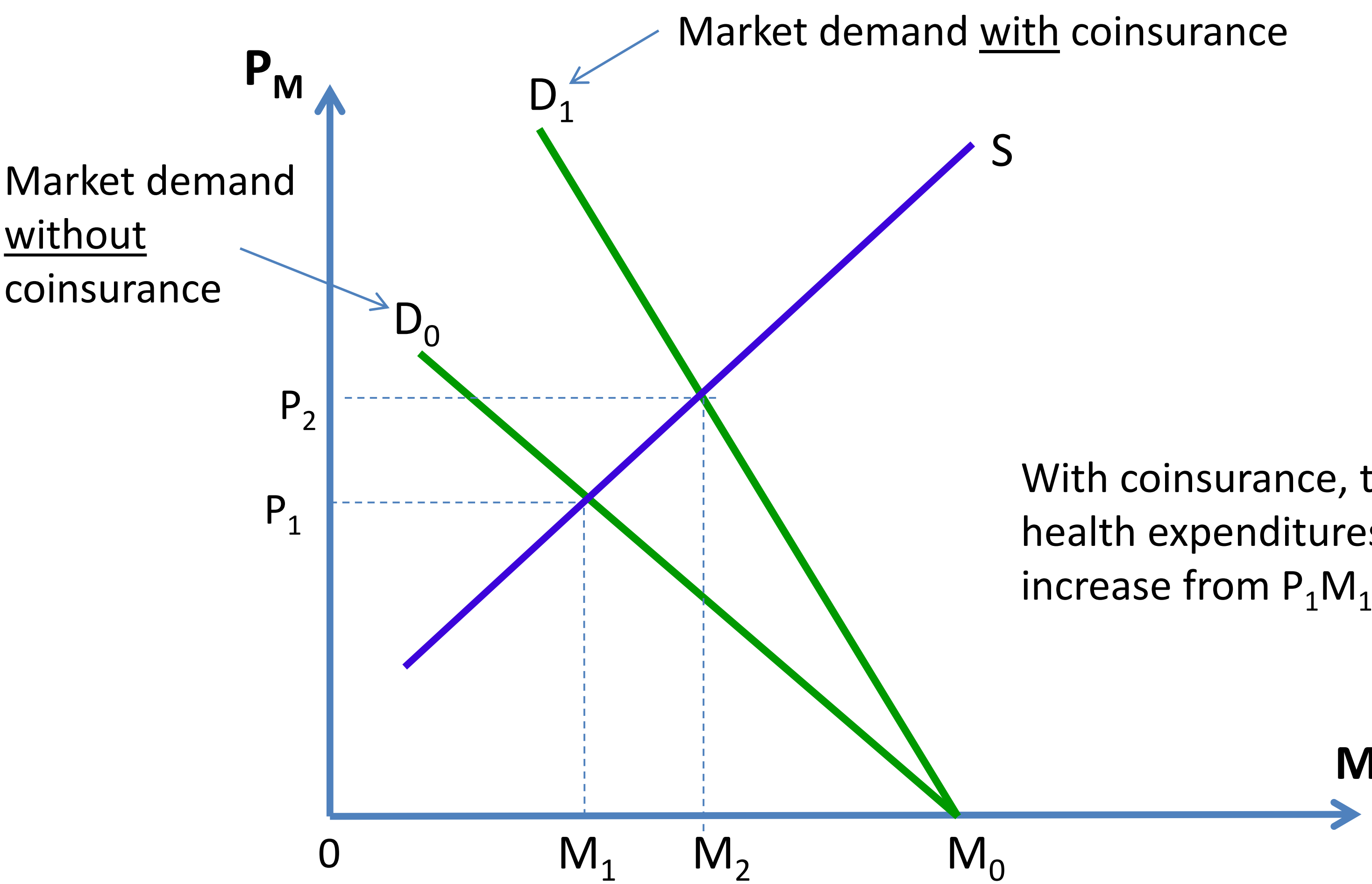
Applications: Time Costs

- People with lower opportunity costs of time would be more likely tolerate or endure long waiting times in clinics or physician offices.
- Even for the poor whose medical care is subsidized, they still have to pay for the time costs.
  - Examples:
    - Medicaid in the US,
    - UC Scheme in Thailand (long waiting time)
  - Solutions:
    - Build health facilities near people's residence
    - ???

Role of a Coinsurance Rate



Market Effects



With coinsurance, total health expenditures will increase from P_1M_1 to P_2M_2.

Empirical Studies

- Demand function for physician visits (V) can be written as:

$$V = f(P, r, t, P_0, Y, HS, AGE, ED, \ldots)$$

where P = price per visit,
r = patient's coinsurance rate,
t = time price,
P_0 = price of other goods,
Y = income,
HS = the patient's health status,
AGE =age, ED = education

- *'Usual'* econometric specification for the above demand function:

$$V = b_0 + b_1P + b_2r + b_3t + b_4P_0 + b_5Y + b_6HS + b_7AGE + b_8ED + \varepsilon$$

$$\text{or } \ln V = b_0 + b_1 \ln P + b_2r + b_3t + b_4P_0 + b_5Y + b_6HS + b_7AGE + b_8ED + \varepsilon$$

⇨

Issues in Empirical Studies on the Demand for Medical Care

- Measurement
  - Measure “medical care/services” in monetary values
    - One problem is that expenditures reflect a complex combination of price of care, quantities of care, and qualities of care
  - Alternative measures :*quantity of visits, patient days, or cases treated*
    - Still have problems with the intensity of care.
- Definition of the price of services
  - Many patients do not pay the full price for their treatments.
- Differences in study populations

Example: Price Elasticities

Study	Dependent Variable	Price Elasticity
All Expenditures:		
Manning et al. (1987)	All expenditures	−0.17 to −0.22
Physician Services:		
Newhouse and Phelps (1976)	Physician office visits	−0.08
Cromwell and Mitchell (1986)	Surgical services	−0.14 to −0.18
Wedig (1988)		
Health perceived excellent/good	Physician visits	−0.35
Health perceived fair/poor	Physician visits	−0.16
Hospital Services:		
Newhouse and Phelps (1976)	Hospital length of stay	−0.06
Manning et al. (1987)	Hospital admissions	−0.14 to −0.17
Nursing Homes:		
Chiswick (1976)	Nursing home residents per elderly population	−0.69 to −2.40
Lamberton et al. (1986)	Nursing home patient days per capita elderly	−0.69 to −0.76

Source: Table 9.2 in Folland et al. (2013)

Example: Income Elasticities

Study	Dependent Variable	Income Elasticity
All Expenditures:		
Rosett and Huang (1973)	Expenditures	0.25 to 0.45
Hospital Services:		
Newhouse and Phelps (1976)	Admissions	0.02 to 0.04
Physician Services:		
Newhouse and Phelps (1976)	Visits	0.01 to 0.04
Nursing Homes:		
Chiswick (1976)	Residents per elderly population	0.60 to 0.90

Source: Table 9.4 in Folland et al. (2013)

All income elasticities are positive, suggesting that medical care is normal goods,
And their values range between 0 and 1, suggesting that it is a necessity.

Other Factors Affecting Demand for Medical Care

- Ethnicity and Gender
  - In general, ‘blacks’ tend to consume less medical care.
  - Females, particularly at child-bearing ages, are heavy users of health care. Also, females generally live longer, so they are predominant among elder patients.
- Urban vs. Rural
  - People living in rural areas use less care. (Access problem? Or, socioeconomic status?)
- Education
  - Educated people are more informed and may demand more health care.
  - Often, education is correlated with income, and income actually leads to more demand for health care.

Other Factors Affecting Demand for Medical Care (Cont'd)

- Uncertainty
  - People demand health care for precautionary purposes, e.g. preventive care.
- Age
  - Grossman: As we age, the depreciate rate gets larger. So, more health inputs are required to restore health.
- Health status
  - The sicker tend to demand more health care.

THE PRODUCTION, COST AND TECHNOLOGY OF HEALTH CARE

Topics

- Production and the Possibilities for Substitution
- Costs in Theory and Practice
- Technical and Allocative Efficiency
- Productive Efficiency
- Frontier Analysis
- Health Care Technological Changes
  - Technological Changes and Costs
  - Price Adjustment When Technology Change Occurs
  - Diffusions of New Health Care Technologies

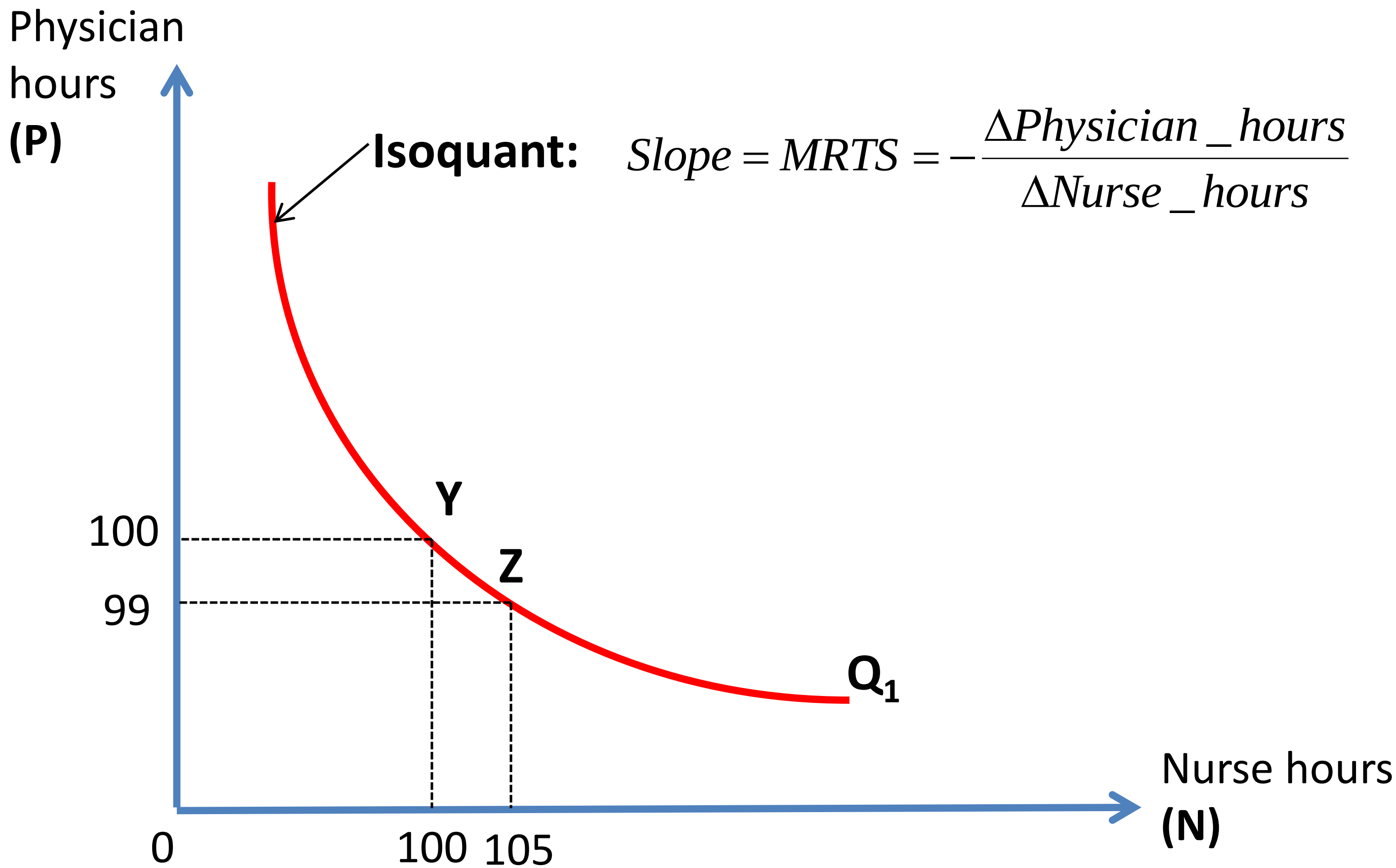
Production

- Short-run production
  - A production in which *at least* one input cannot be modified within a given period of time.
  - Fixed inputs – fixed at all levels of output, e.g. capital, salary
  - Variable inputs – vary by the amount of output, e.g. labor
- Long-run production
  - A production in which *all inputs* can be changed over time

Possibilities for Substitution

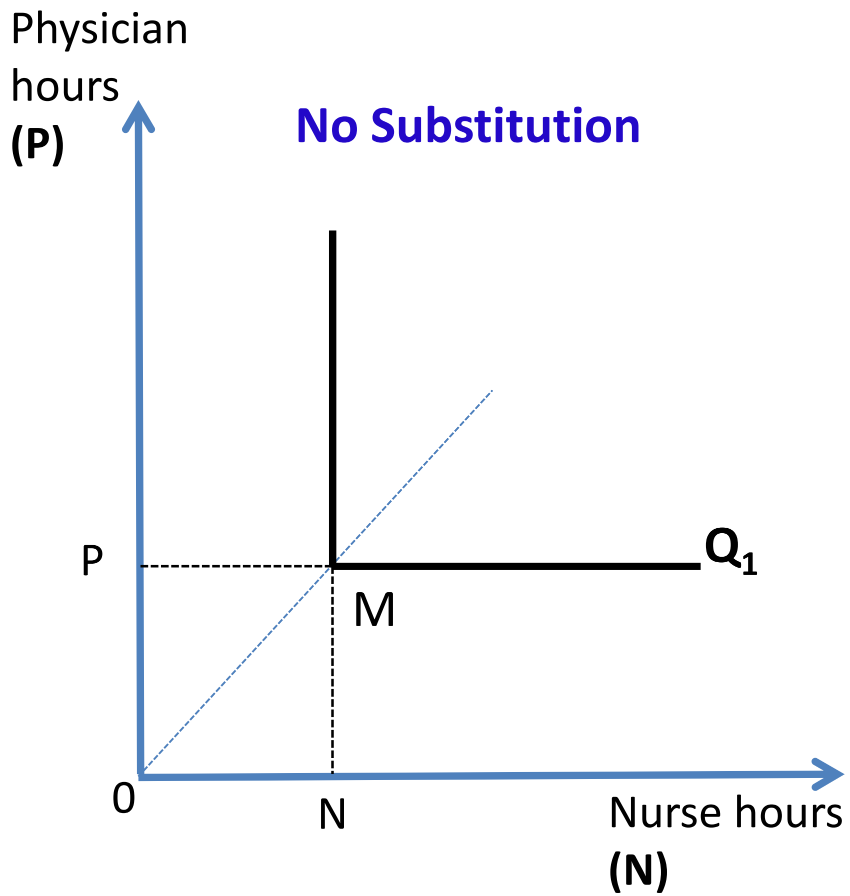
- Now, consider the production with *more than two variable inputs* (e.g. physicians and nurses).
- We are interested in the ability to substitute one input (e.g. physicians) for another input (e.g. nurses) while maintaining the same level of output.
- The degree to which one input can be replaced by another input, while output remains constant, is measured by the *slope of the isoquant*, which is equal to the marginal rate of technical substitution (MRTS).

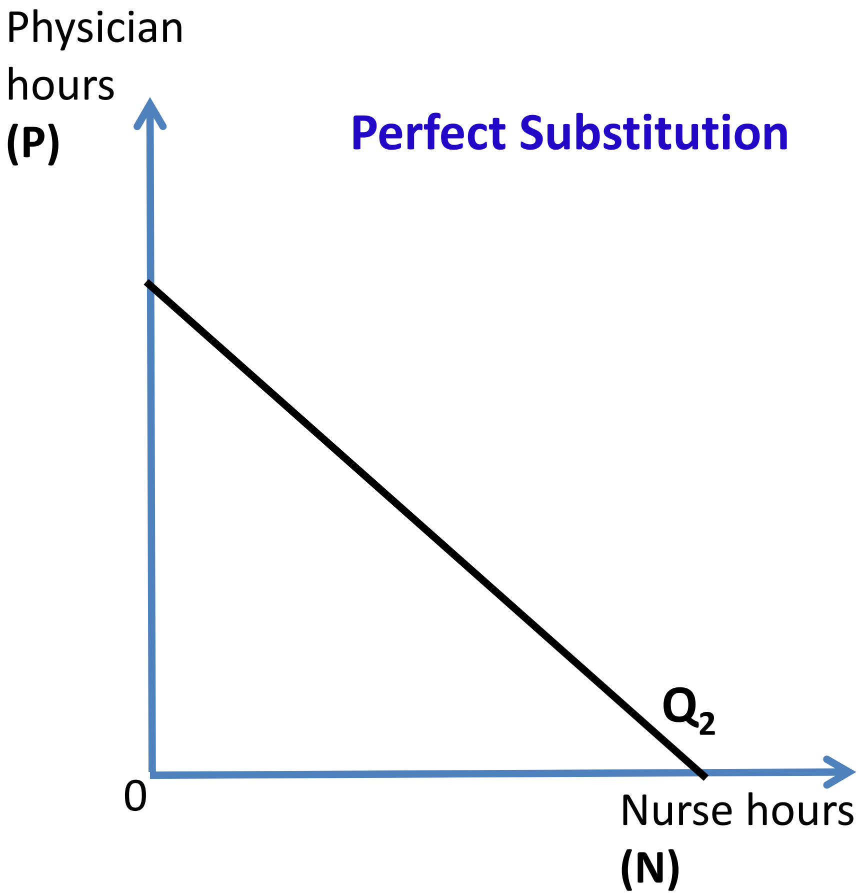
Substitution between Physicians and Nurses



$$Slope = MRTS = -\frac{\Delta Physician\_hours}{\Delta Nurse\_hours}$$

Substitution: Extreme Cases





Question: Would these two cases be possible in the real world?

Elasticities of Input Substitution

- If an input price changes, a cost-minimizing firm would respond by shifting away from the *costlier* input to the *cheaper* input.
- The new input combination is determined by the elasticity of substitution of inputs.
- The elasticity of substitution (E_S) measures the responsiveness of a cost-minimizing firm to changes in relative input prices:

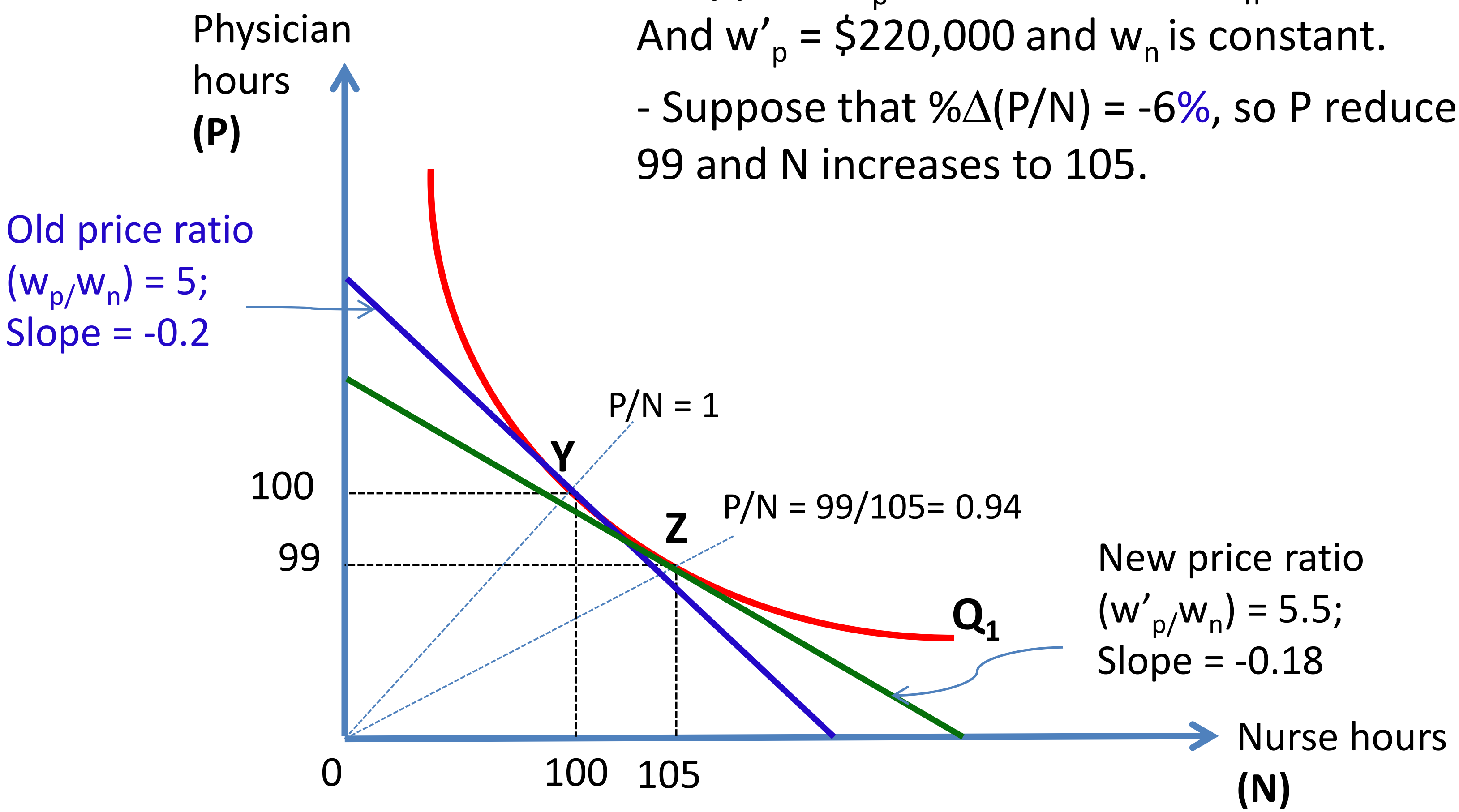
$$E_s = \frac{\text{Percentage change in factor input ratio}}{\text{Percentage change in factor price ratio}}$$

- Example: Suppose M = f(P, N), and factor prices are Wp and Wn.

$$\boxed{E_S = \frac{\%\Delta(P/N)}{\%\Delta(W_p/W_n)} = \frac{\Delta(P/N)}{P/N} \times \frac{W_p/W_n}{\Delta(W_p/W_n)}}$$

Substitution between Physicians and Nurses

- Suppose w_p = \$200,000 and w_n = \$40,000
And w'_p = \$220,000 and w_n is constant.
- Suppose that %Δ(P/N) = -6%, so P reduces to 99 and N increases to 105.



Input Substitution: Application

- E_s = -0.6 means that, as input price ratio increases by 1%, the input ratio would decrease by 0.6%.
- The absolute values of E_s range between 0 and ∞.
  - $E_s = 0$ ➔ No substitutability
  - Larger E_s ➔ Greater potential for substitutability
- The concept of input substitution can be applied particularly to the *long-run production*, where all inputs are flexible.
- Other examples of input substitution:
  - Substitution between health workers and new technology
  - Substitution between local physicians and foreign physicians

Deriving Cost Curve

- Hospital's cost minimization problem:

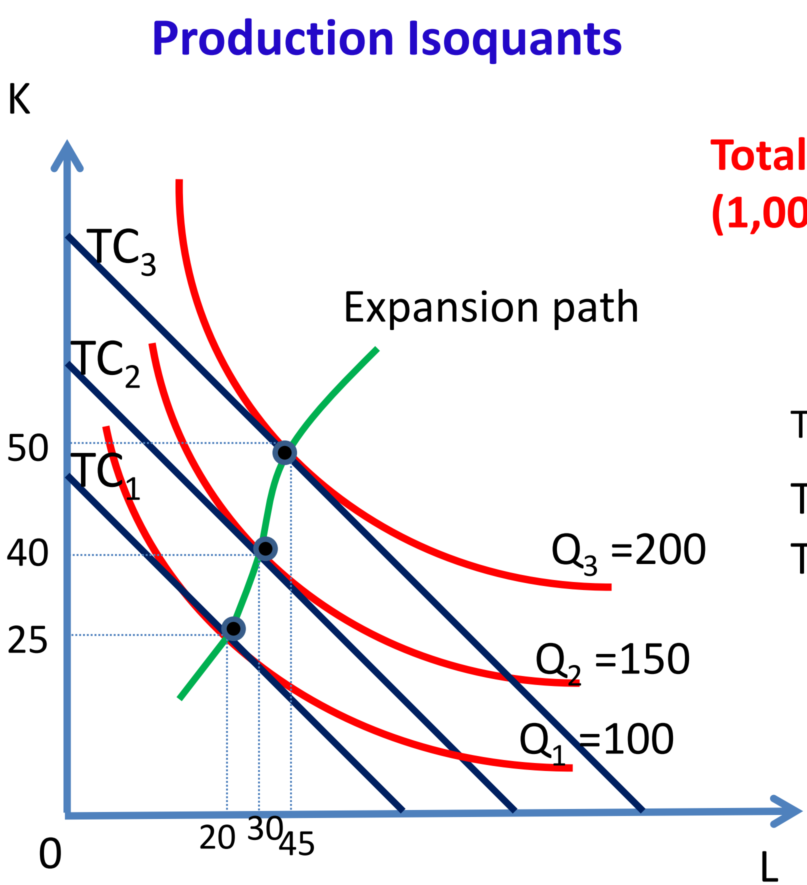
  Min TC = rK + wL

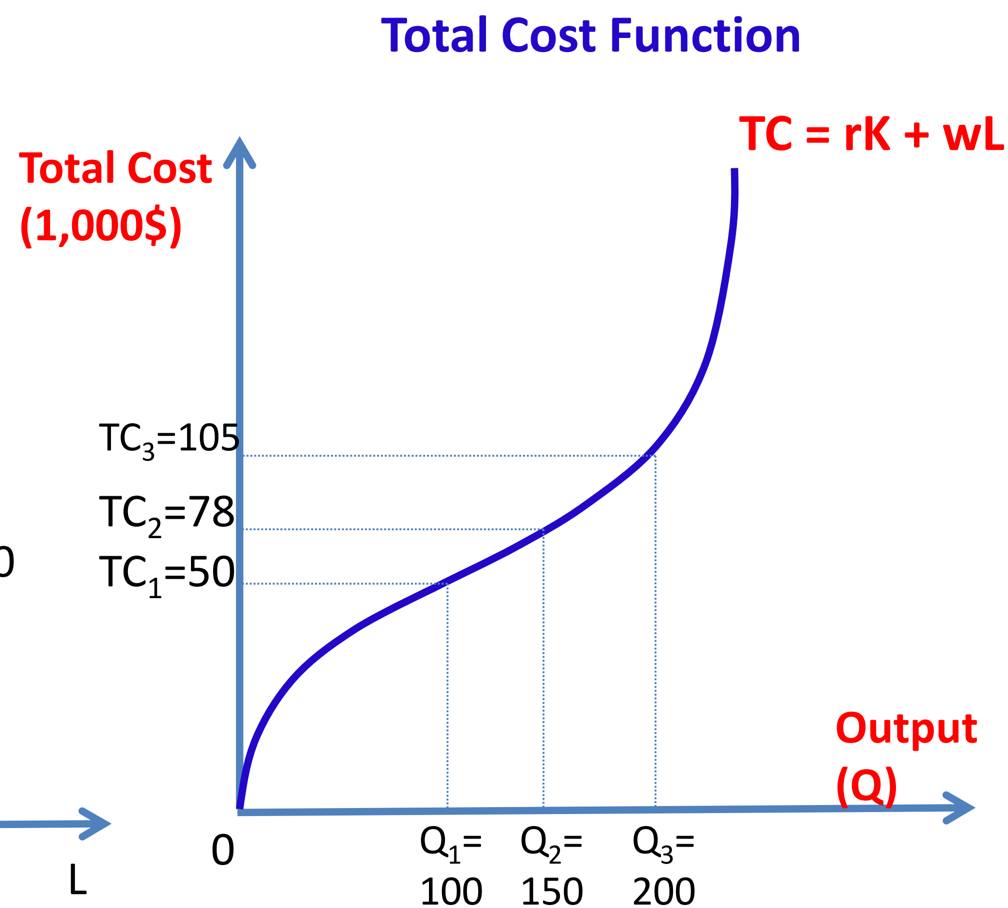
  Subject to Q*=Q(K, L)

  ➔ (K*,L*) is the input combination that gives the least cost at a given output level.

- The set of all possible points of tangency between the isocost curves and the isoquants is called the expansion path.
  - This curve tells the relationship between a given output level and its minimum cost.

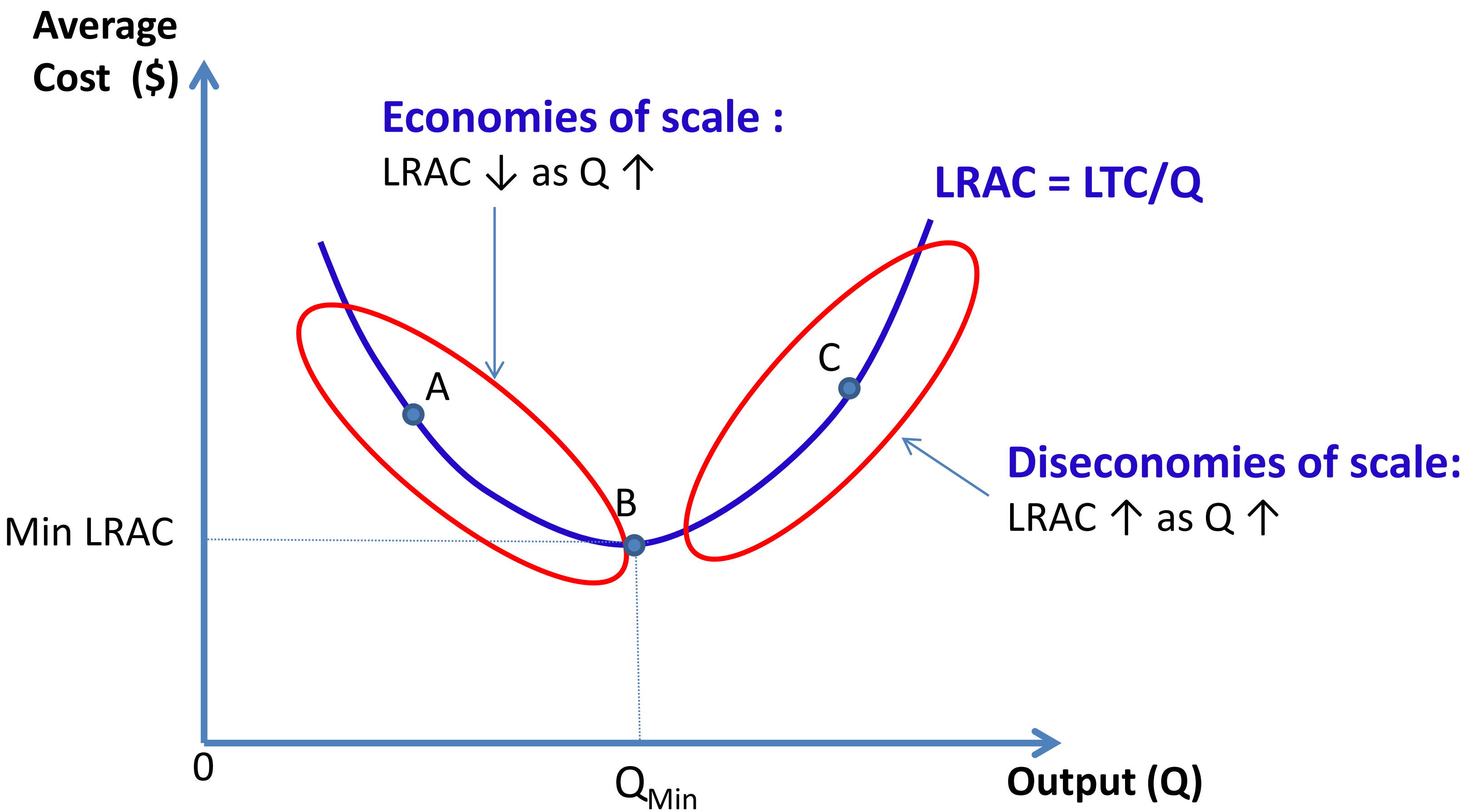
Cost Function





Suppose input prices are r = \$1,200 and w = \$1,000.

Economies of Scale



Economies of Scope

- Definition:

  For a multiproduct firm, economies of scope occur whenever it is possible to produce two or more goods jointly more cheaply than they can be produced separately.

- Mathematically, suppose a firm has 2 outputs Q_1 and Q_2. Economies of scope exists if:

$$TC(Q_1, Q_2) < TC(Q_1, 0) + TC(0, Q_2)$$

where $TC(Q_1,Q_2)$ = the joint cost of producing both outputs together

$TC(Q_1,0)$ = the cost of producing output 1 only

$TC(0,Q_2)$ = the cost of producing output 2 only

Significance of Economies of Scale and Economies of Scope

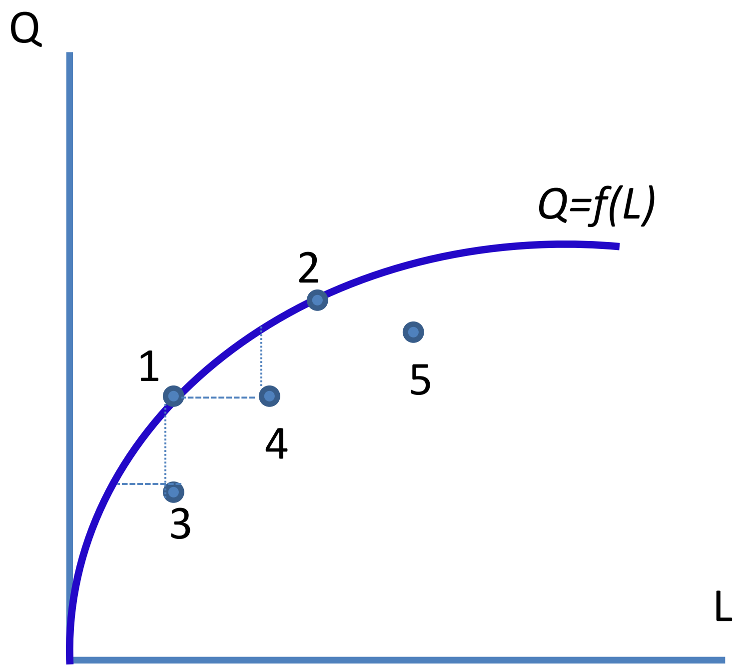
- Both concepts can provide implications to public policy and to managerial policy.
- Economies of scale:
  - Profit-maximizing firm
    - ➢ Prefers to produce where AC is still decreasing
  - Society's perspective
    - ➢ Prefers lowest average costs (not necessary where it max π)
- Economies of scope:
  - Provision of different departments in the same hospital
  - Subsidization in teaching hospitals

Efficiency

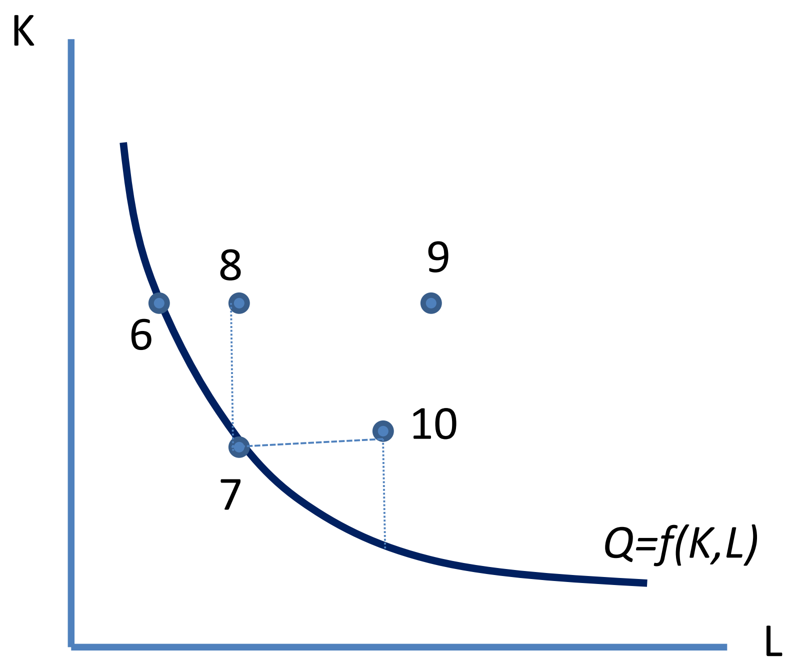
- Technical efficiency
  - Applies to production within a given firm
  - Technical efficiency is achieved when a maximum output is being produced from a given input combination.
- Allocative efficiency
  - Requires the efficient allocation of inputs between firms and between outputs.
  - Allocative efficiency is achieved when inputs are put into their best uses so that no further gains in output are possible.
- Productive efficiency
  - There could be many different levels of output that are allocative efficient (i.e. total costs are minimized).
  - Of all the least cost levels of output, the "most least cost" level of output is productively efficient.

1. Technical Efficiency

- 1 Input

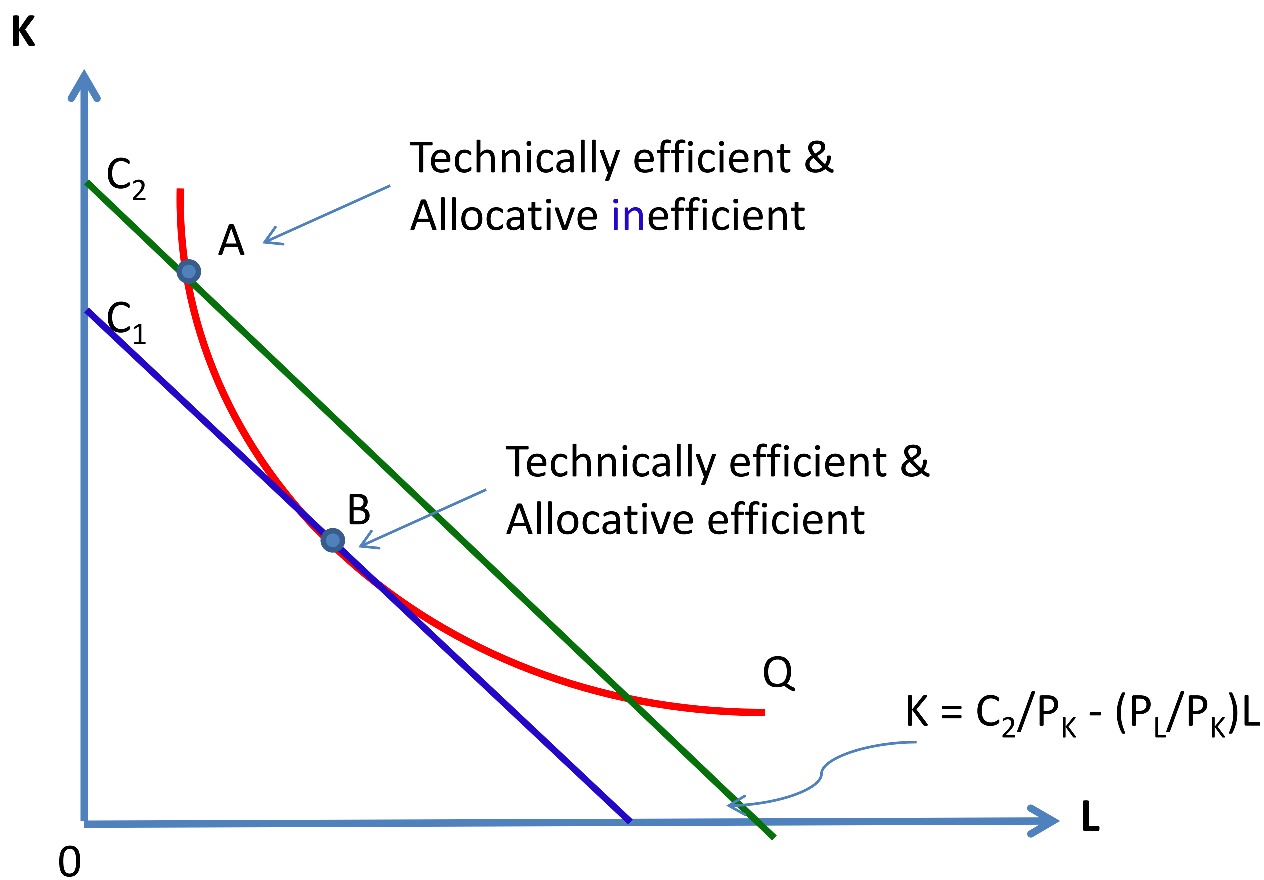


- 2 Inputs



Technical inefficiency results when a firm uses more resources than necessary to produce a given level of output.

2. Allocative Efficiency

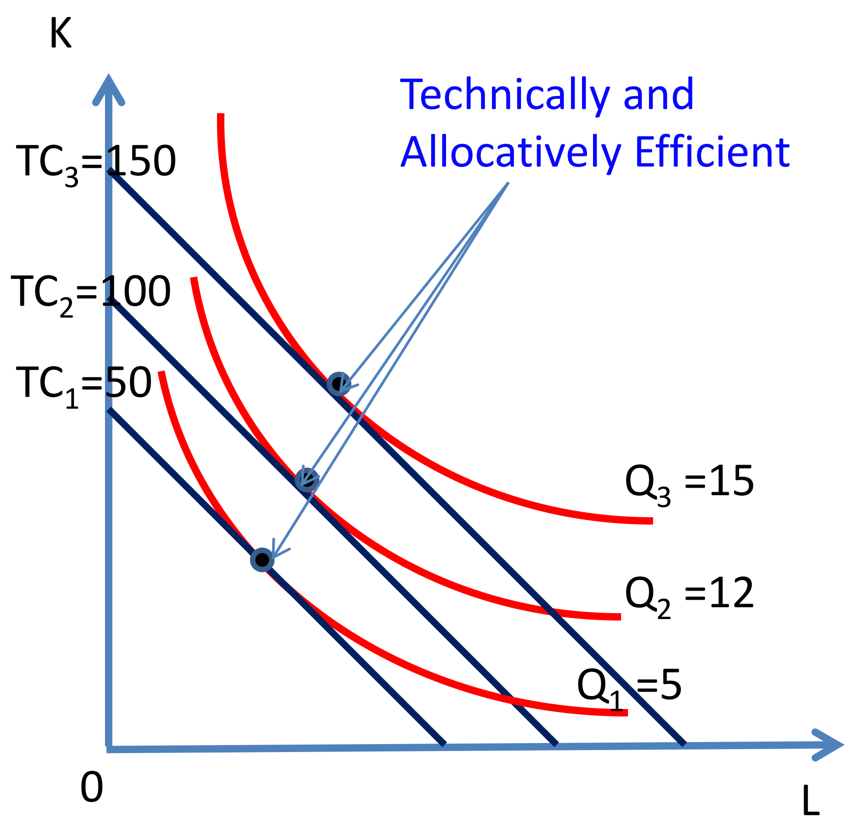


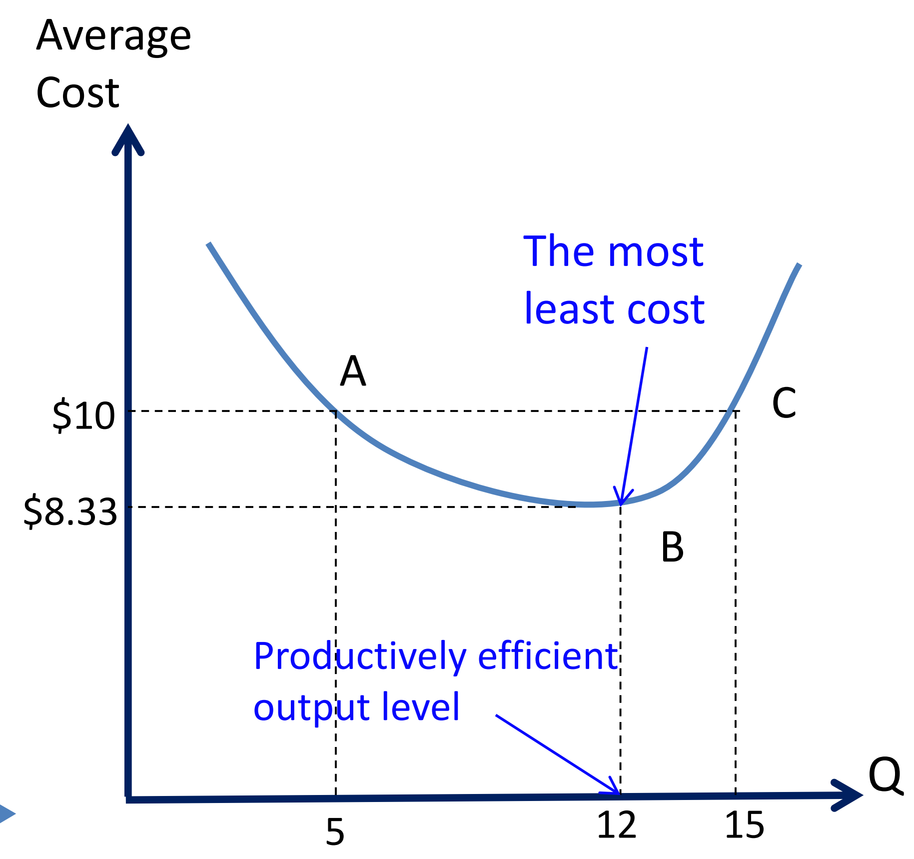
Technical and Allocative Efficiencies

Technology	K	L	Cost (if P_K=10, P_L=5)
A	3	4	\$50
B	4	2	\$50
C	3	3	\$45

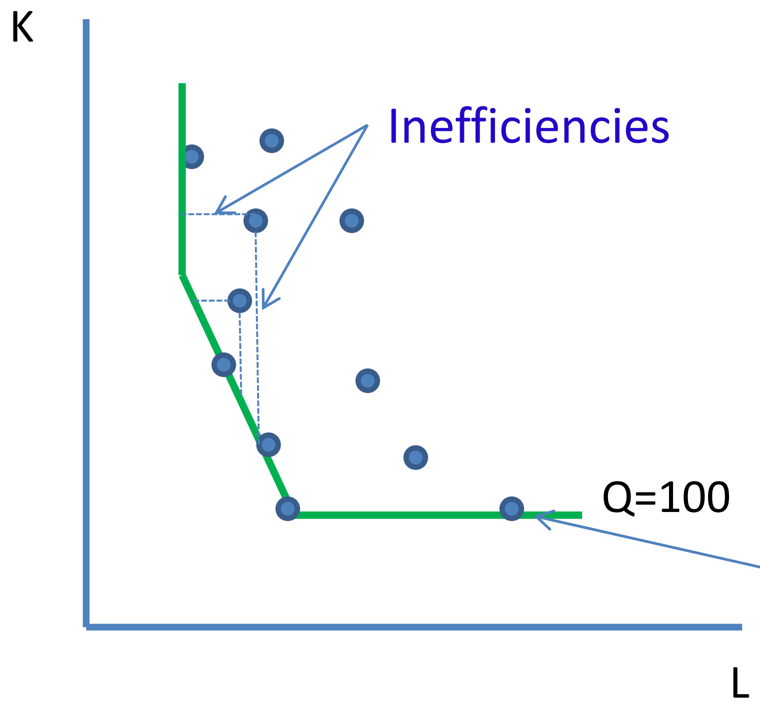
- Suppose P_K = 10 and P_L= 5, which technology is allocatively efficient?

3. Productive Efficiency





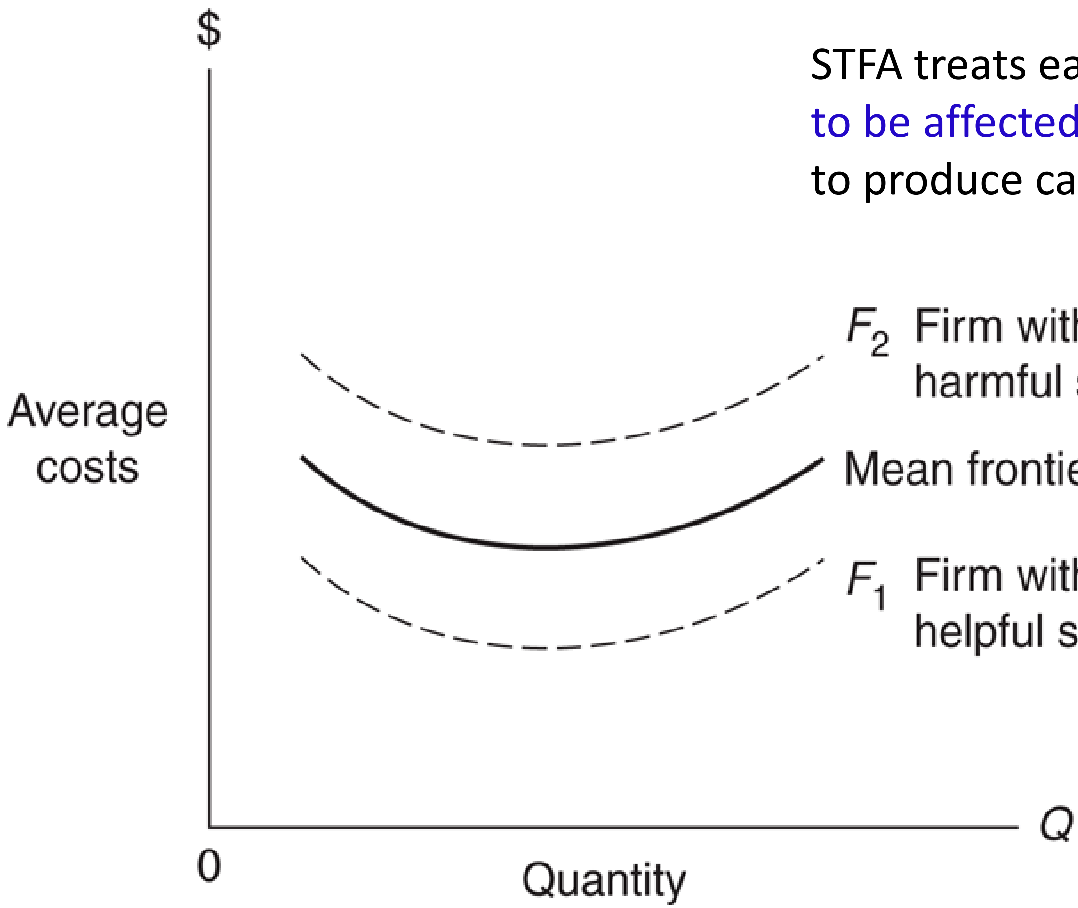
Frontier Analysis: Data Envelope Analysis



The Data Envelope Analysis (DEA) identifies the efficient outer shell enveloping the data.

Deterministic frontier (found by using linear programming)

Frontier Analysis: Stochastic Frontier Analysis (STFA)



STFA treats each firm uniquely by assuming it to be affected by a potential shock to its ability to produce care.

Frontier is stochastic.

Inefficiency score is calculated from the residuals obtained from SCF model.

Case Study:
Efficiency of Public Hospitals in Thailand

(Source: Patamasiriwat, 2011)

- Examined cost efficiency of 3 different types of public hospitals in Thailand:
  - Regional hospitals (23)
  - Provincial hospitals (58)
  - Community hospitals (629)
- Focused on technical efficiency and looked at the cost side
  - Costs: Wage, personal compensations, operating expenses, material costs, utilities, others
- Estimated cost function: $C = f(OP, IP) = OP^a x IP^b$
  - Regional hospitals: constant returns to scale (i.e. $a+b = 1$)
  - Community & Provincial hospitals: decreasing cost (i.e. $a+b <1$)

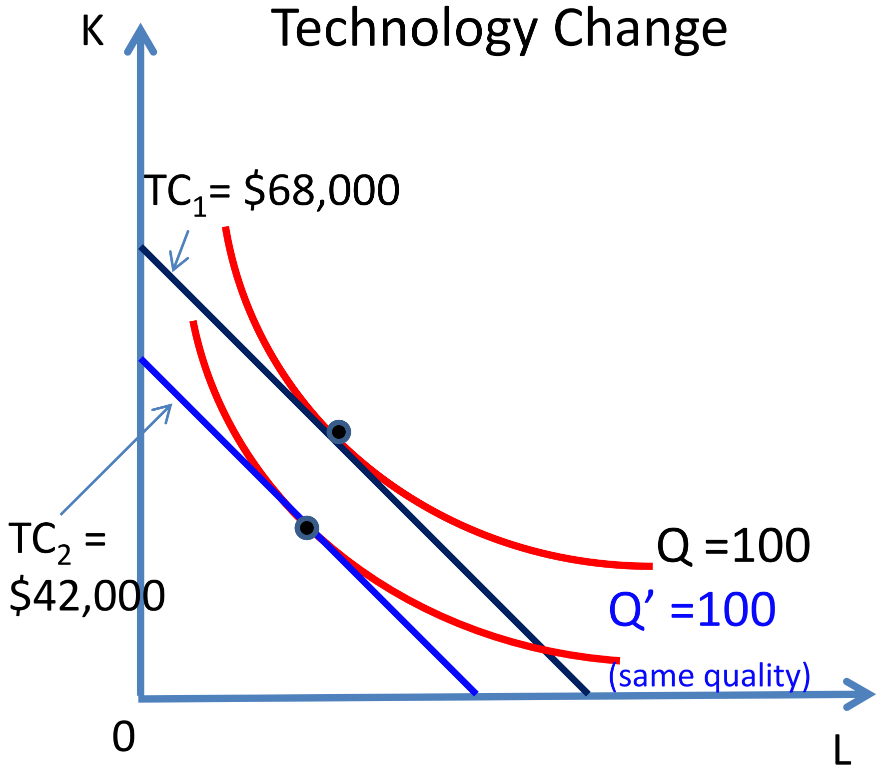
Case Study:
Efficiency of Public Hospitals in Thailand

(Source: Patamasiriwat, 2011)

- 2 Methods to determine efficiency: DEA and STFA
  - Regional hospitals: Efficiency score = 0.94 (i.e. "output slack" =6%)
  - Provincial hospitals: Efficiency score = 0.64
  - Community hospitals: Inefficiency score=0.186 → Efficiency score = 0.814
- Limitations:
  - Ignore other types of hospital outputs (teaching, research, health promotion)
  - Did not consider quality of care or severity of different health care cases
- Discussion:
  - ➢ Provincial and community hospitals might operate at less than full capacity
  - ➢ There were signs of resource underutilization.

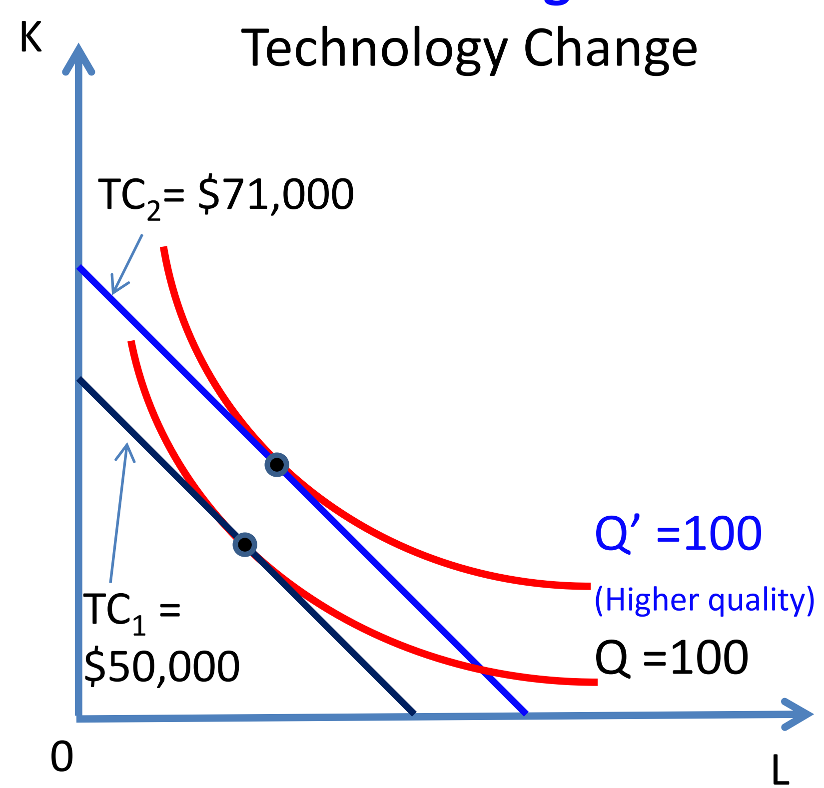
Technological Changes and Costs

Cost-Decreasing due to Technology Change



Technology change increases the productivity of health resources.

Cost-Increasing due to Technology Change



Technology change improves quality of care or introduce costlier products.

Health Care Prices with Technological Change Occurs

- <u>Question</u>: Whether technological changes really cause the inflation in the health care sector?

➢ Not necessarily!

  ➢ New treatments are *not* included in the fixed basket when calculating CPI.

  ➢ Improvement in the treatment effectiveness could be omitted.

    - Example: New treatments reduce the length of hospital stay. By putting more weight on the room charge, the price index is overestimated.

  ➢ Not taken into account the improvement in quality of life of the patients.

Adjustment in Health Care Prices

- Example: Cutler et al (1999) developed two quality adjusted price indexes of myocardial infarction treatment

Unadjusted Indexes	Avg. Price Changes	Quality-Adjusted Indexes	Avg. Price Changes
Official MCPI	3.4%	Quality (extra years of life)	-1.5%
Heart attack episode approach	2.8%	Quality (extra QALYs)	-1.7%

- Technological change has *improved the quality of treatment*.
- The quality adjustment can prove that the heart attack treatment *price* is actually *declining* (price deflation).