Week 3: Healthcare Supply

HPM 6503
Spring 2026
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Week 3: Outline

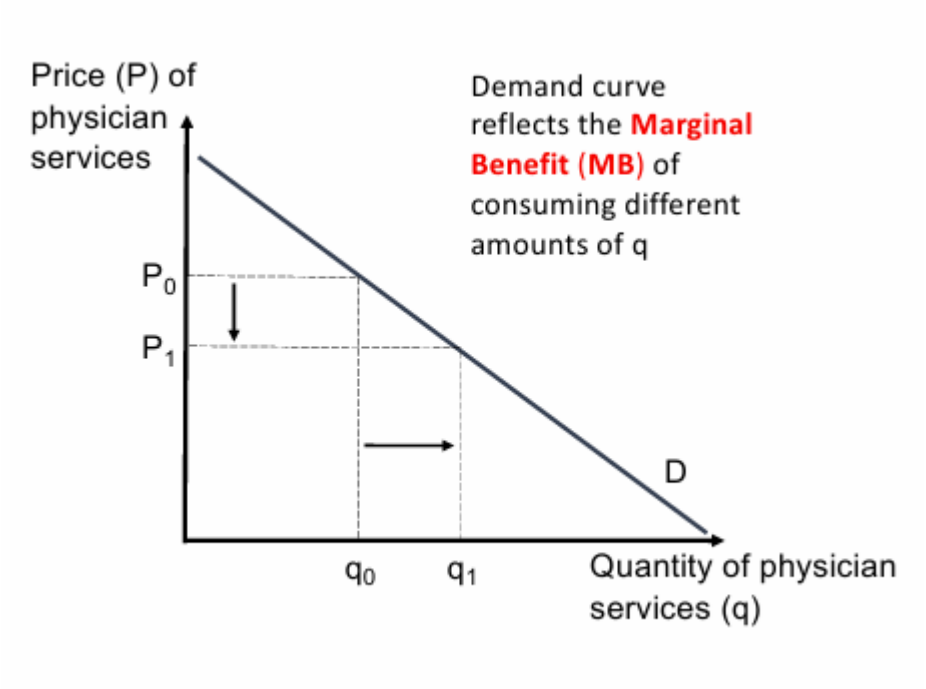
- Announcements
- Last week review
- Firms & profit
- Supply curve & supply shifters
- Elasticity

Announcements

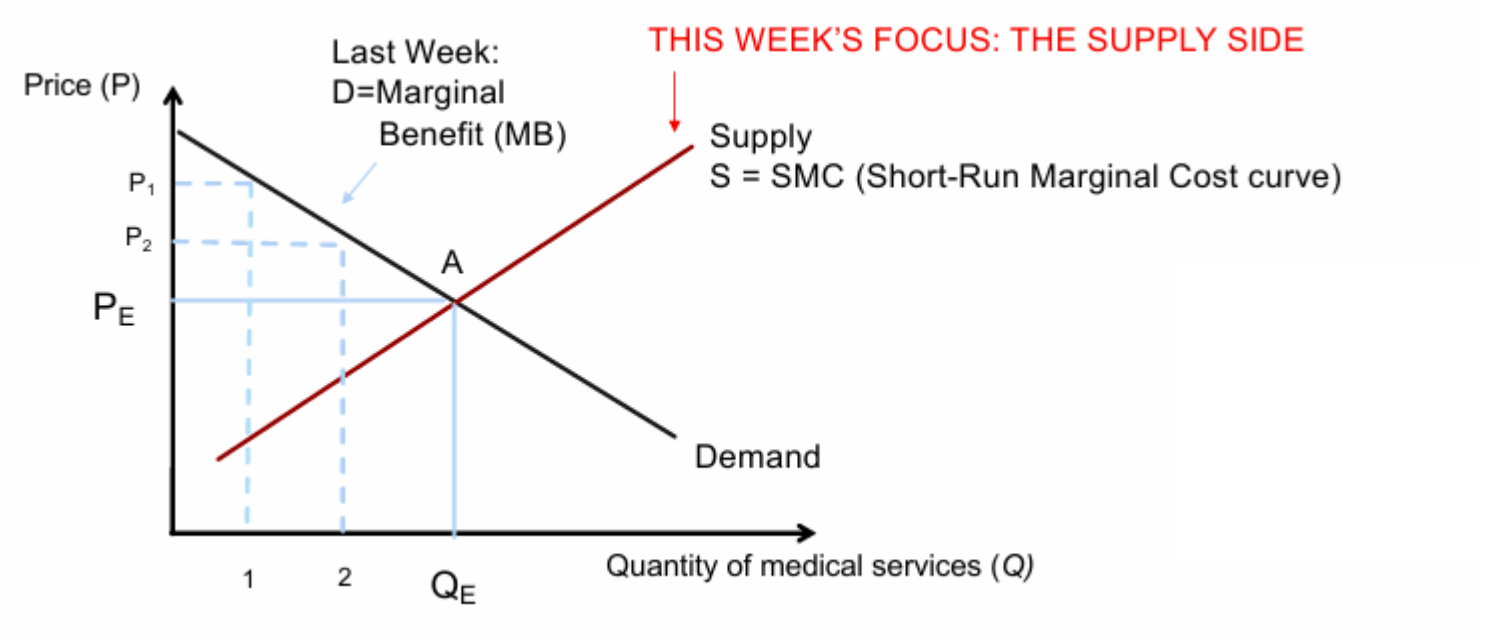
- Accommodations for Exam 1
  - Exam 1 will be from 6pm-8:20pm
  - Exam 1 will be a 2 hour exam
  - Office of ODS will reach out to students with registered accommodations to schedule their exam, most likely 5:30pm-9pm on the 18th
  - No other accommodations will be granted
  - Exam will be set up on canvas
  - Review sessions will be announced next week
- Attendance & Participation grade
- Guest speaker confirmed!

Last Week Recap: Demand Curve for Physician Services

- Utility & preferences
- Demand for health vs. health care
- Health stock as a production and as a resource
- Marginal Benefit of consuming different amount of medical care
- Elasticity of demand



Today's Focus: Medical Care Production & Costs



But first, let's back up: Firms maximize profit

For profit firms have one goal above all else: maximize profit

$$\Pi = revenue - costs$$

$$Revenue = Price * quantity$$

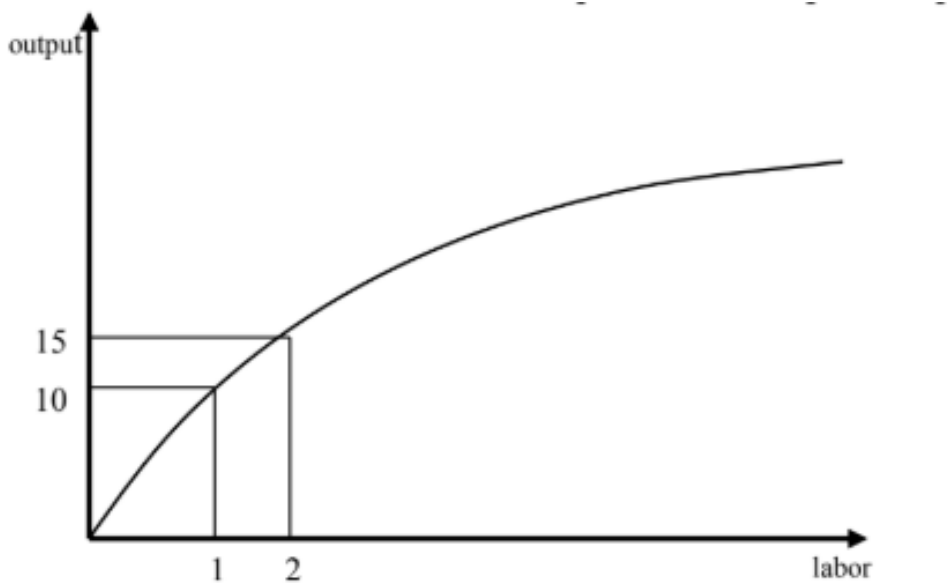
$$Costs = Cost * quantity$$

$$\Pi = p * q - c * q$$

Production Function

Little control over price or cost → Firms mostly control output **quantity q**

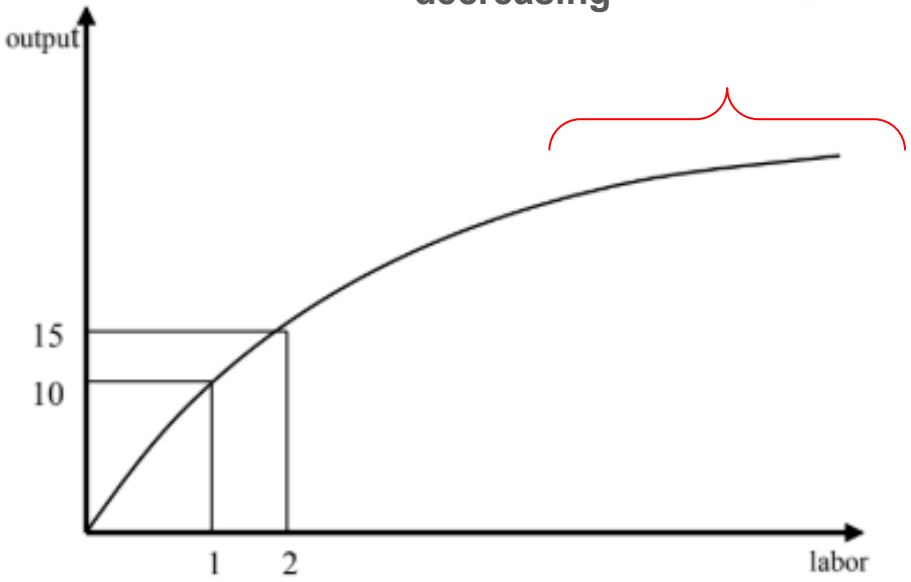
Production function relates quantities of input (e.g. labor, capital) to quantity of output (e.g. medical services)



Production Function

$$q = f(n, \bar{k})$$

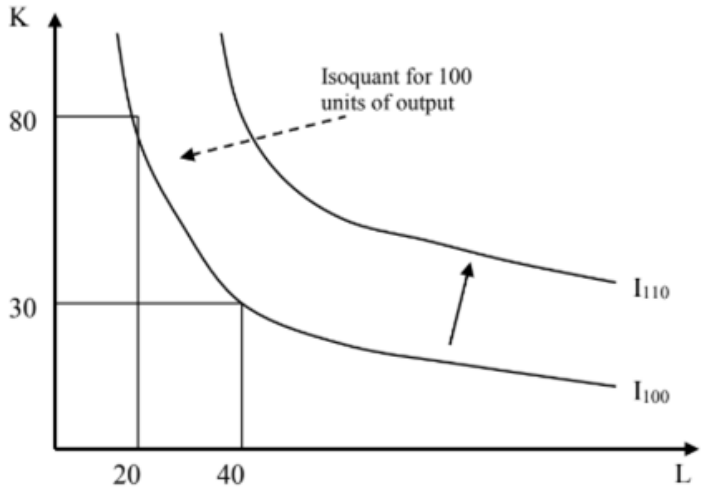
Diminishing returns of labor → MP of labor is decreasing



Isoquant

Definition

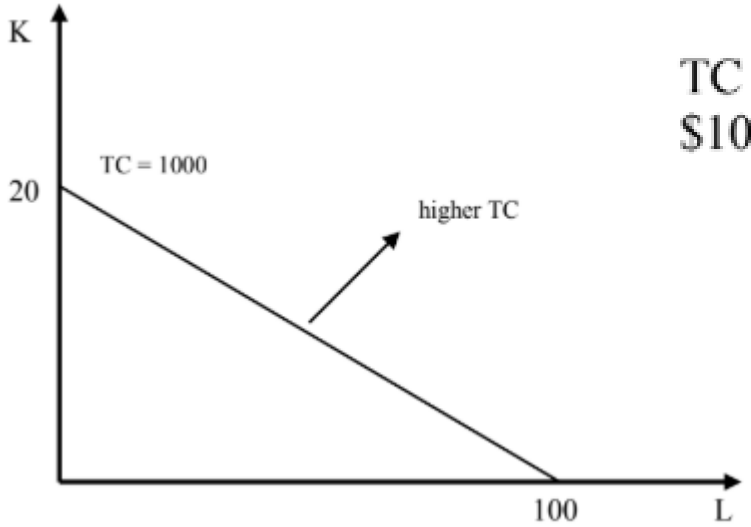
Isoquant: specifies various input combinations needed to produce a given level of output



Isocost

Definition

Isocost: relates all the combinations of inputs that cost a given amount



$$TC = wL + rK$$
$$\$1000 = 10L + 50K$$

How do firms maximize profit (graphically)?

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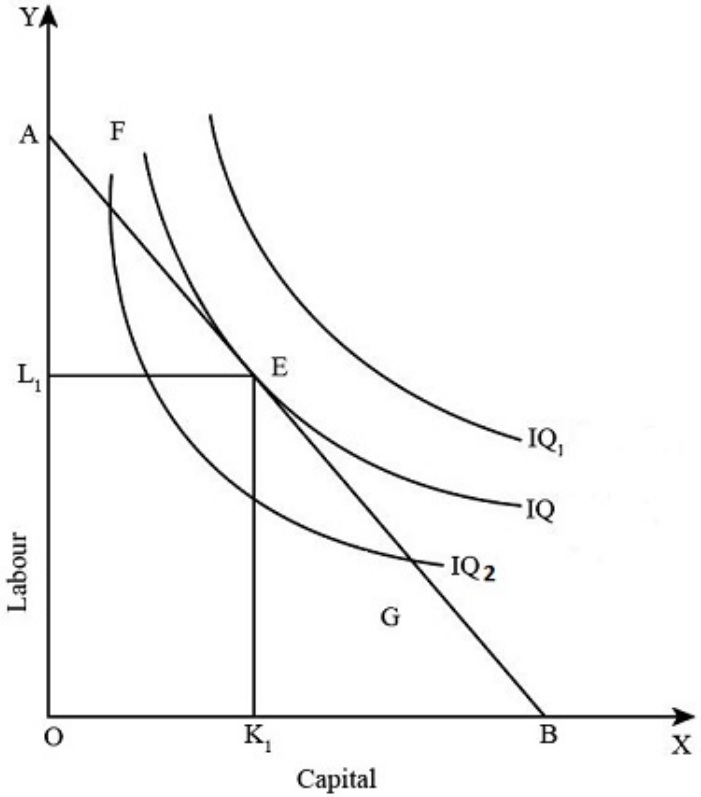


Firms maximize profit

Firms' objectives:

$$\Pi = revenue - costs$$

- Maximize revenue
- **Minimize costs:** for each output level q, the firm chooses the lowest-cost isocost that still touches the isoquant for that output quantity q.
  - Minimum costs for each isoquants builds the **cost function C(q)**

Fixed vs. Variable Costs

In the short run, 2 types of costs: Fixed and Variable

Fixed costs do not depend on the output of the firm. Physician has an office, rented for 5k/month. That cost does not vary based on the number of patients they see. Same with equipment, like MRI scanner, which costs ~2m regardless of 20 vs. 2000 patients.

Variable costs vary with output. Each patient you see you need a tongue depressor, needles for blood, electricity to administer tests. Labor can also be a variable cost, as more staff may be needed as number of patients grow.

Fixed vs. Variable Costs

- Short run vs. Long Run

Some things are fixed in the short run but constraints can be addressed in the long run → In the long run, all costs are variable

Definition

The short run is the period in time in which the level of at least one input cannot be changed

Average vs. Marginal Costs

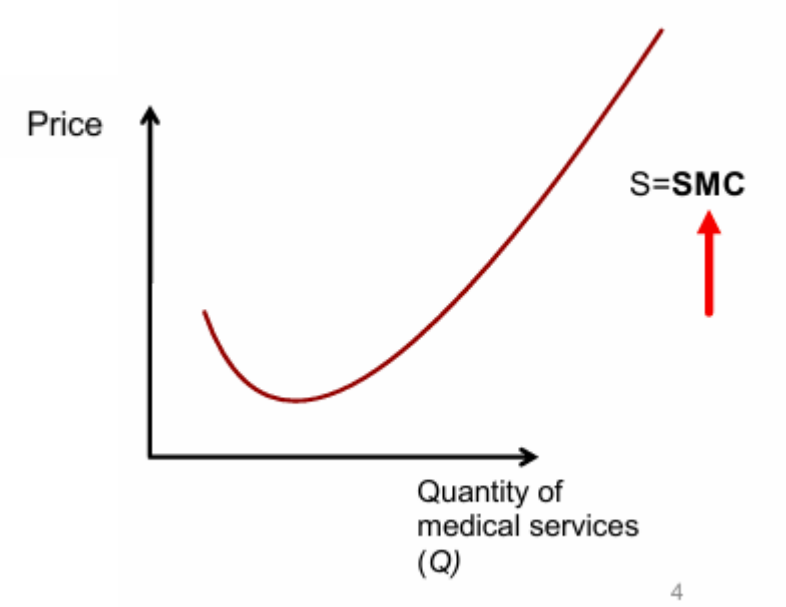
Average costs = total costs/quantity produced = (fixed + variable costs) / quantity

Marginal costs = additional costs from producing the **next unit of output**. Fixed costs don't affect marginal cost

$$MC = \Delta TC/\Delta Q = \Delta VC/\Delta Q$$

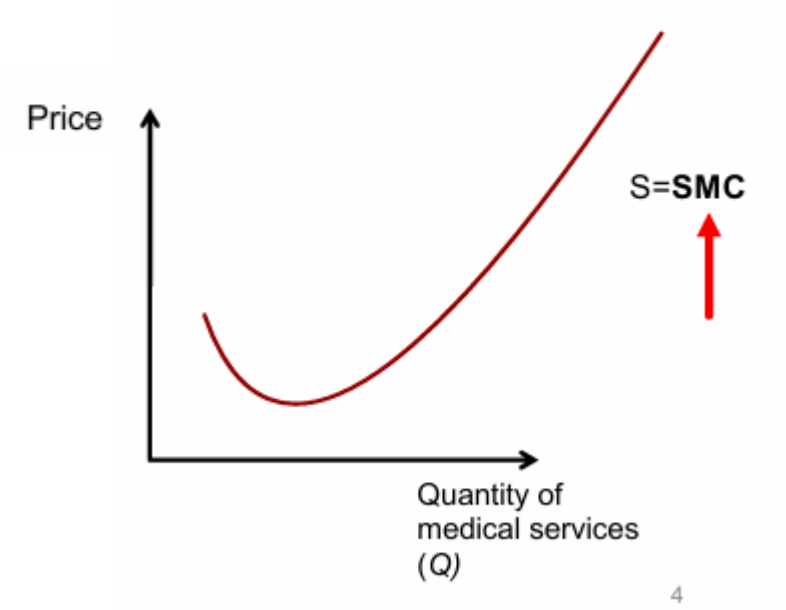
From Isocost to Supply Curve

Supply Curve represents the relationship between product price and quantity supplied



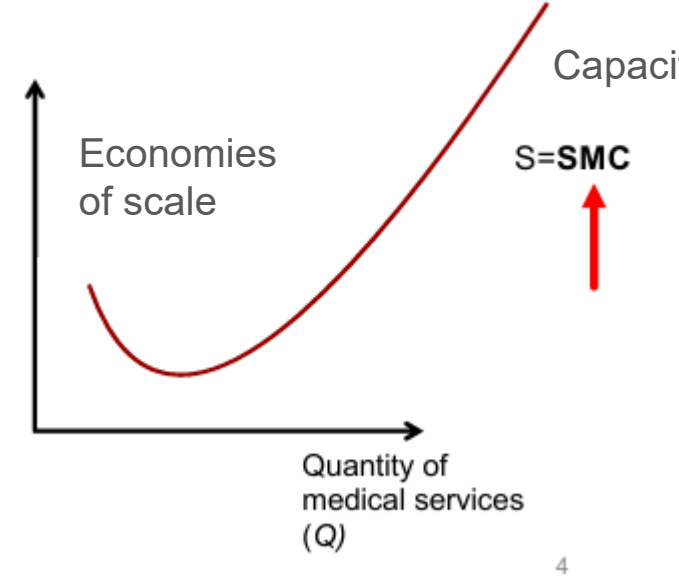
From Isocost to Supply Curve

Supply Curve is actually the **Short-Run Marginal Cost Curve**



From Isocost to Supply Curve

Supply Curve is actually the **Short-Run Marginal Cost Curve (SMC)**



Costs & Productivity

The relationship between productivity & costs is **negative**

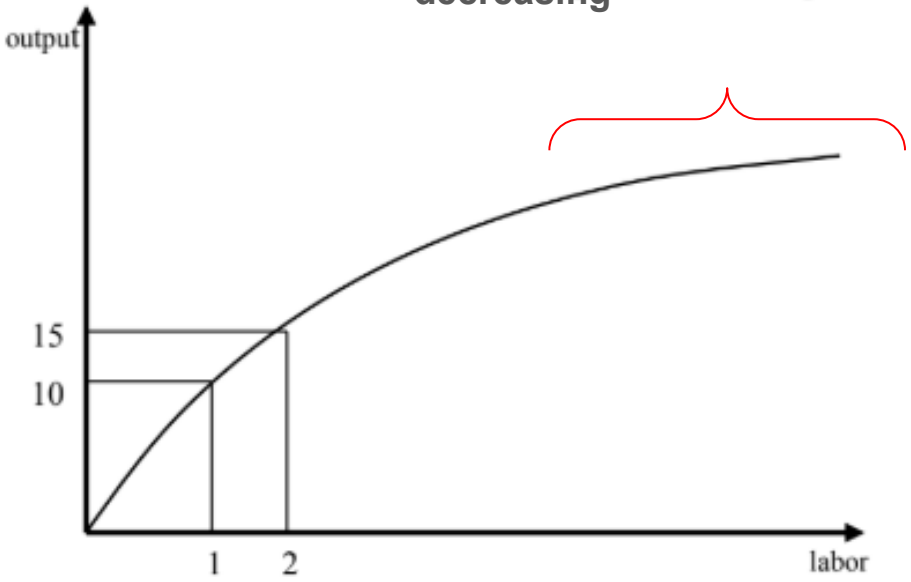
If productivity of an input (a worker's hour) goes up (worker works faster) the cost of producing a good goes ***down.***

Production Function: identifies different ways the inputs can be combined to produce different levels of outputs

Production Function

$$q = f(n, \bar{k})$$

Diminishing returns of labor → MP of labor is decreasing

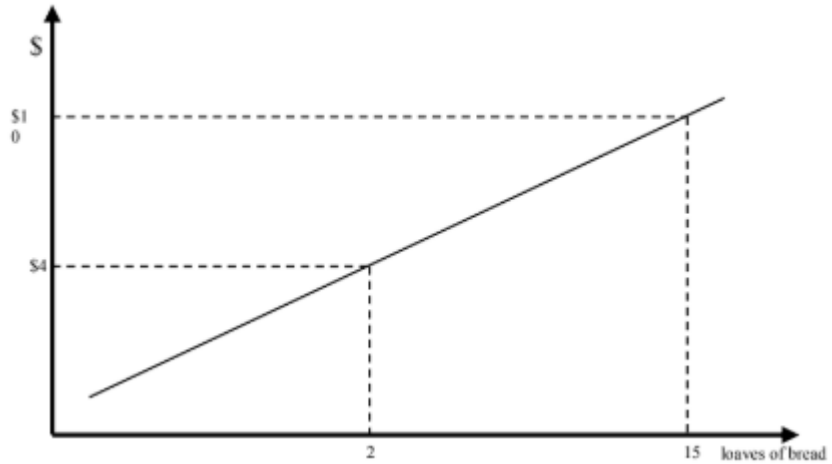


Attendance

Attendance Form Health Econ

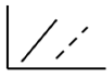
Supply Curve

Supply: relationship between quantity supplied and product price (ceteris paribus

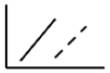


Supply Shifters

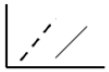
1. technology: ↑ technology =>



2. input prices: ↓ P =>



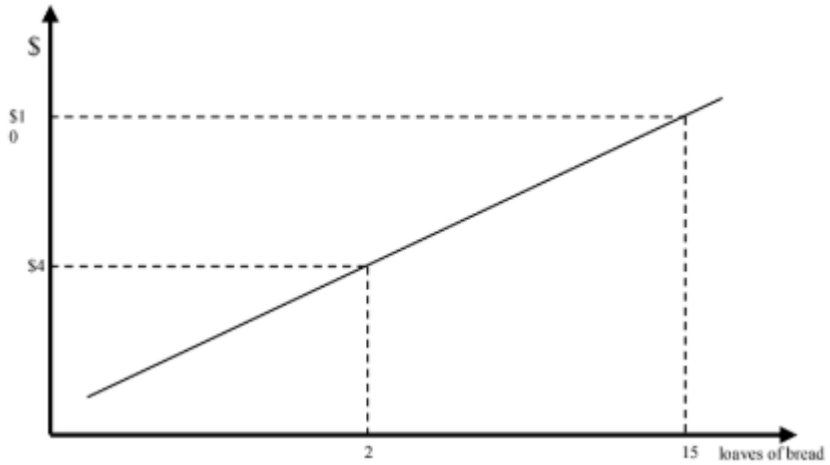
3. price of production alternative: ↑ P_A =>



(grapes and raisins)

Supply Curve

Slope indicates elasticity of supply



slope indicates responsiveness
: very responsive (elastic)

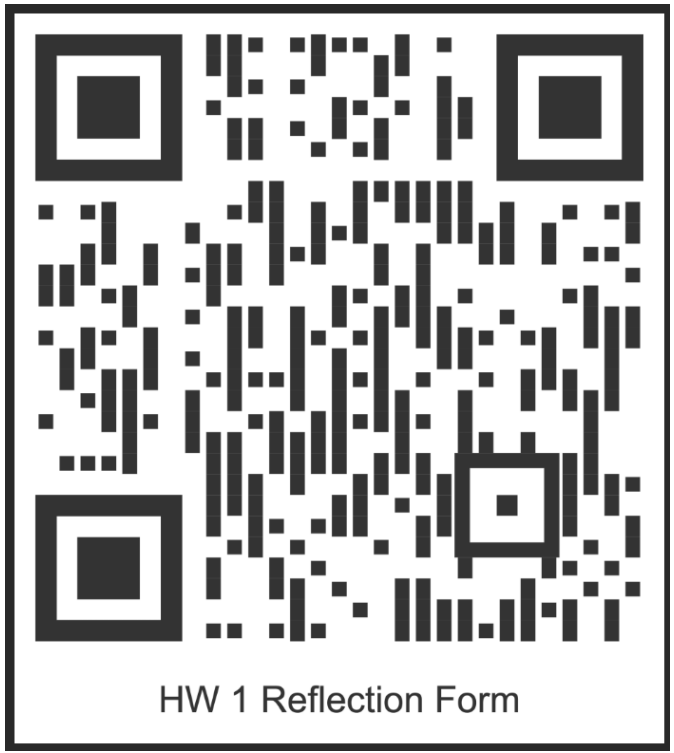
: not very responsive (inelastic)

Elasticity of supply

$$1.\ e_s = \frac{\%\ \text{change in } Q_s}{\%\ \text{change in P}}$$

$$E_s = \frac{\Delta Qs/Qs}{\Delta P/P} = \frac{\Delta Qs}{\Delta P} * \frac{P}{Qs}$$

Break



HW 1 Reflection Form

SR Production Function of a Medical Firm - Assumptions

1. Medical firm produces a single output of medical services q
2. Only two medical inputs: nurse-hours n (labor) & composite capital good k
3. Quantity of capital is fixed at some amount
4. Production Efficiency: Medical firm faces an incentive to produce as efficiently as possible
5. Medical firm possesses perfect information regarding the demand for its product

Short Run Production Function of a Medical Firm

The Production Function:

- Identifies different ways nurse-hours & capital can be combined to produce various levels of medical services
- Different levels of output produced by
  - Different combinations of the nursing and capital inputs
  - Each combination assumed to be technically efficient (i.e. maximum amount of output q is produced given the state of technology)

$$q = f(n, \bar{k})$$

Short Run Production Function of a Medical Firm

Units of Labor (L)	Total Output (Q) (e.g., patient contacts)
0	0
1	50
2	120
3	200
4	250
5	270
6	280
7	260
8	230

An Example of a "Generic" Total Product Curve

Short Run Production Function of a Medical Firm

Total Product Curve: Depicts total output produced by different levels of the variable input, holding all other inputs constant

Law of diminishing marginal productivity:

- At first, total output increases at an increasing rate
- After some point, it increases at a decreasing rate
- And then it will begin to decrease

Marginal Product

Definition:

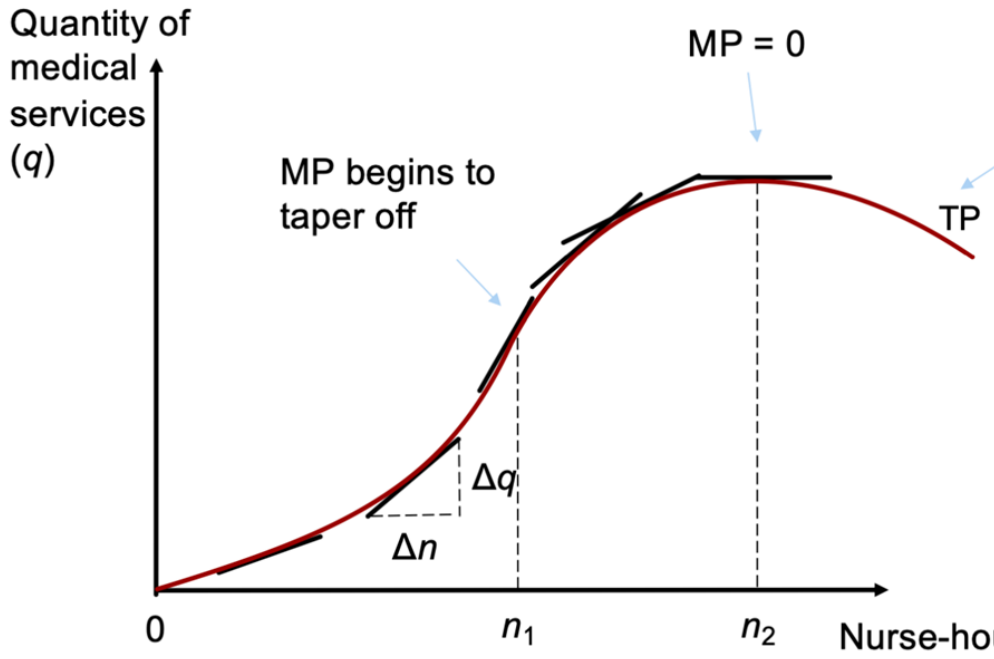
Change in total output associated with a one-unit change in the variable input

$$MP_n = \Delta q / \Delta_n$$

Magnitude of the marginal product of a nurse-hour reveals the additional quantity of medical services produced by each additional nurse-hour

- Initially, increasing marginal productivity, but eventually diminishing marginal productivity

Marginal Product



Don't forget: This is In the short-term – Capital is fixed

Diminishing marginal productivity is the reason why output fails to expand at an increasing rate after n_1 nurse-hours.

The total product curve shows that output initially increases at an increasing rate from 0 to n_1 nurse-hours, then increases at a decreasing rate from n_1 to n_2 nurse-hours, and finally declines after n_2 nurse-hours as the medical firm employs more nurse-hours.

Average Product

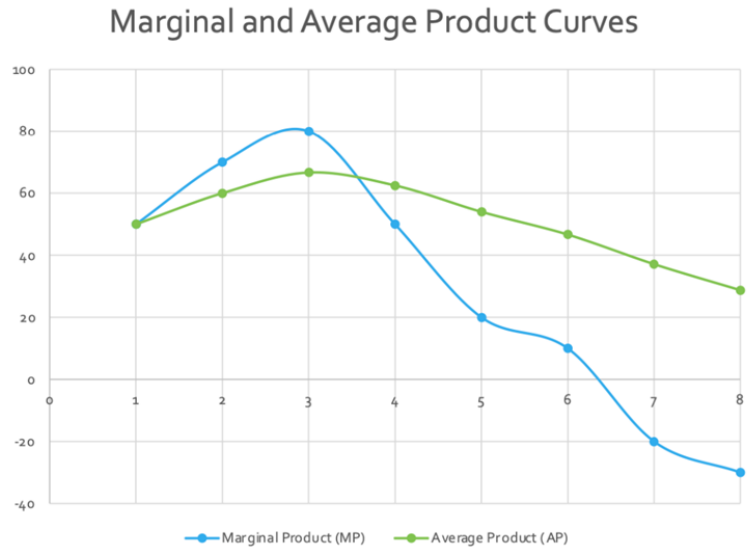
Average product, AP_n = Total quantity of medical services divided by the total number of nurse-hours

$$AP_n = q/n$$

Initially increases, then reaches a maximum, then decreases due to diminishing marginal productivity

Marginal vs. Average Product

Units of Labor (L)	Total Output (Q)	Marginal Product (MP)	Average Product (AP)
1	50	50	50
2	120	70	60
3	200	80*	66.7*
4	250	50	62.5
5	270	20	54
6	280	10	46.7
7	260	-20	37.1
8	230	-30	28.8



Marginal vs. Average Product

Units of Labor (L)	Total Output (Q)	Marginal Product (MP)	Average Product (AP)
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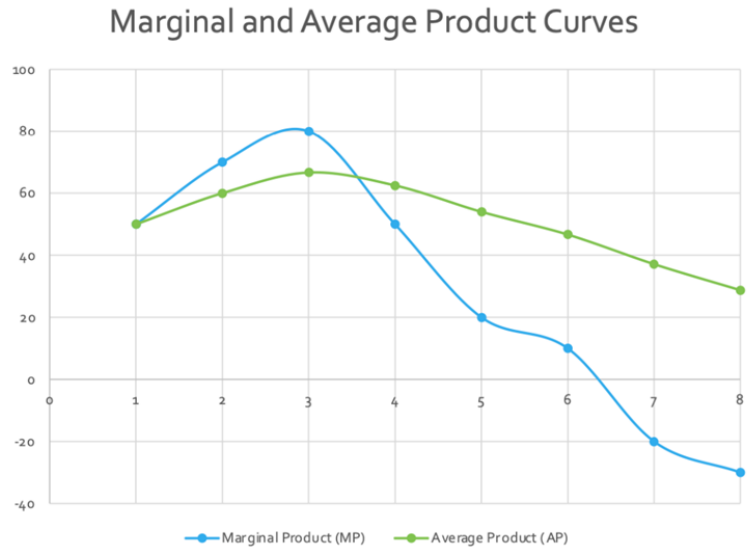


Average productivity rises when marginal productivity exceeds average productivity. Average productivity falls when marginal productivity lies below average productivity. Marginal productivity equals average productivity when average productivity is maximized.

Back to Costs

Total costs = Explicit Costs + Implicit Costs

Explicit Costs = salaries, utility bills, supplies

Implicit Costs = opportunity cost of the resources (e.g. rental price of MRI)

Back to Cost: Short Run Total Cost Function

$$STC(q) = \underbrace{w \times n}_{\text{Variable costs}} + \underbrace{r \times \bar{k}}_{\text{Fixed costs}}$$

- Level of medical output: q
- Variable input nurse-hours: n
- w = hourly wage for a nurse
- Fixed input capital: k
- r = “rental” or opportunity cost of capital
- Input prices - Assumed fixed

Short Run Total Cost = SR Variable Cost + SR Fixed Cost

1. Total variable cost of production, STVC

In this example, STVC=Total worker wage bill = Wage rate * the number of nurse-hours

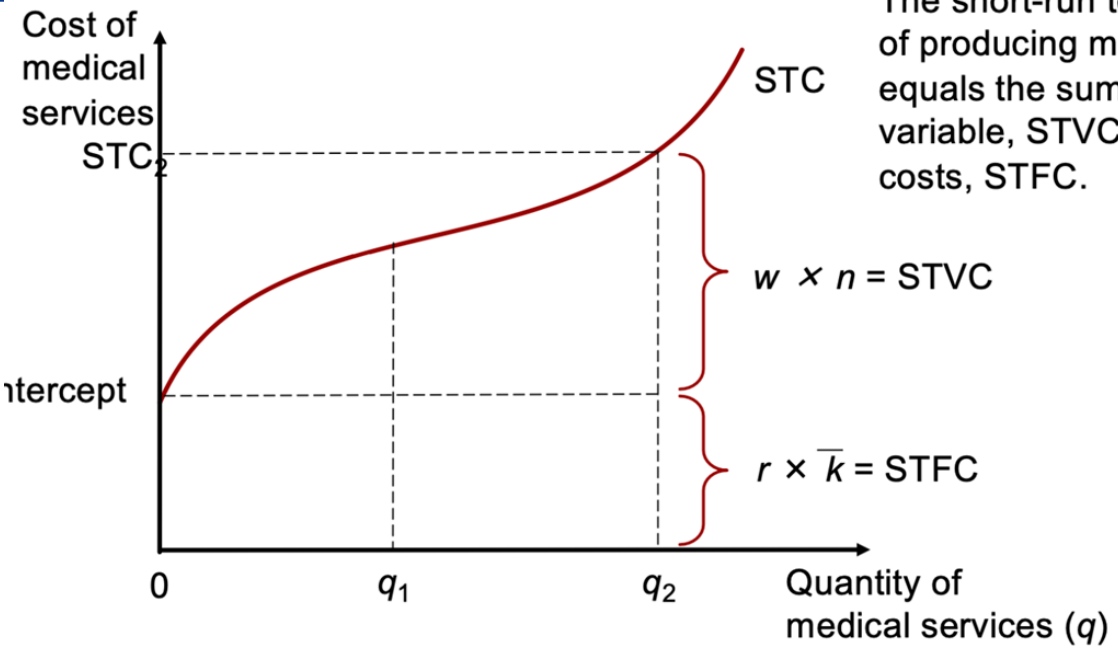
Responds to changes in the level of output

2. Total fixed costs of production, STFC

In this example, STFC=Rental price * the quantity of capital

Does NOT respond to changes in output

The Short-Run Total Cost Curve



The short-run total cost, STC, of producing medical services equals the sum of the total variable, STVC, and fixed costs, STFC.

Note the inverse relationship between productivity & costs. The STC curve is the same shape as the TPC curve – Just flipped upside down & shifted up to account for STFC (fixed costs).

STC first increases at a decreasing rate up to point q_1 and then increases at an increasing rate with respect to producing more output. STC increases at an increasing rate after q_1 because of diminishing marginal productivity.

Source: Santerre & Neun, Fig. 7-5

Relationship between TPC & STC

Relationship between STC and TP

- When TP is increasing at an increasing rate
- STC – increasing at a decreasing rate
- When TP increasing at a decreasing rate
- STC - increasing at an increasing rate

Short Run Per unit Cost of Production

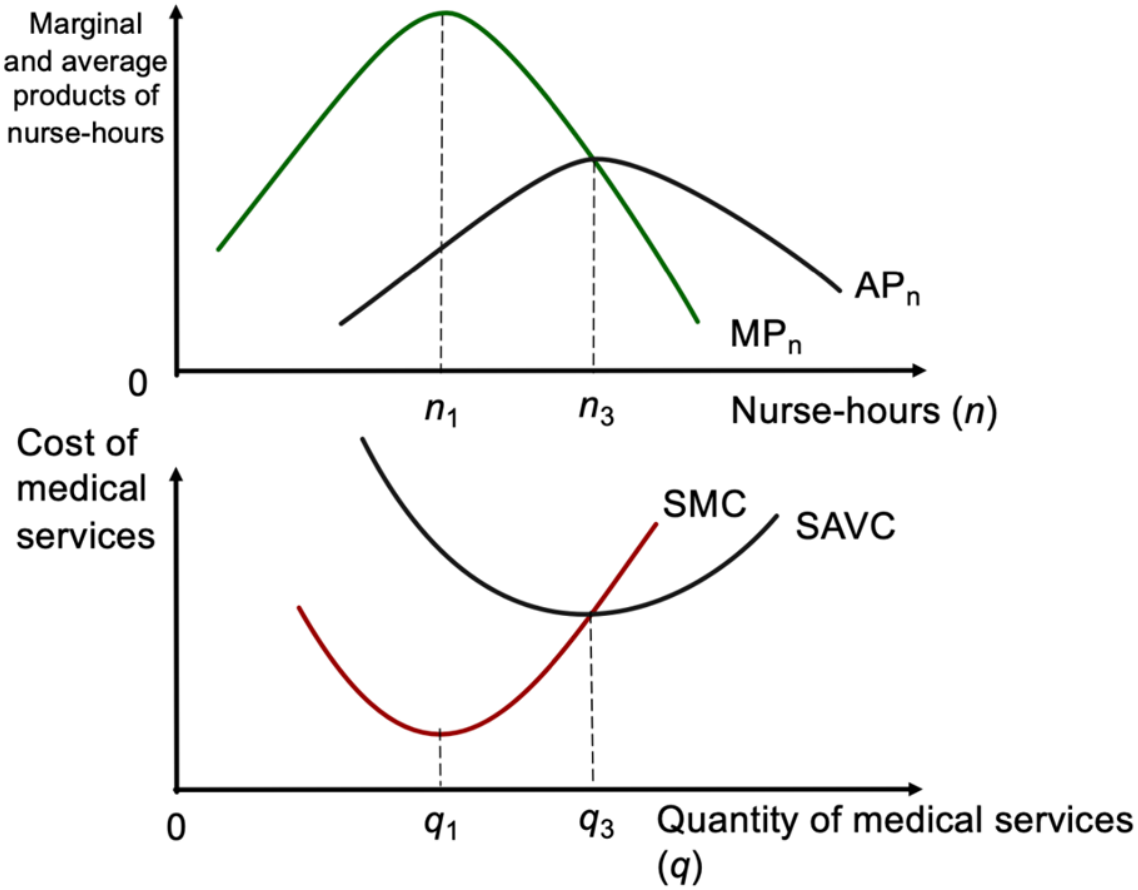
Short-run MARGINAL costs:

SMC = Change in total costs associated with a one-unit change in output

$$SMC = \Delta STC / \Delta q$$

$$SMC = \Delta(w \times n + r \times \bar{k}) / \Delta q$$

$$SMC = w \times (\Delta n / \Delta q) = w \times (1 / MP_n) = w / MP_n$$



Short-run marginal cost, SMC, equals the change in total costs brought on by a one-unit change in output. Short-run average variable cost, SAVC, equals short-run total variable cost divided by total output. SMC and SAVC are inversely related to marginal and average productivity. For example, marginal costs decline as marginal productivity increases.

Source: Santerre & Neun, Fig. 7-6