

Intermediate Microeconomics

Chapter 9 Cost

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Cost

- In order to attain production efficiency, firms need to be able to minimize cost
- In this chapter, we will look at how the firm chooses its optimal input combination for a given level of output
- We will distinguish between short and long run

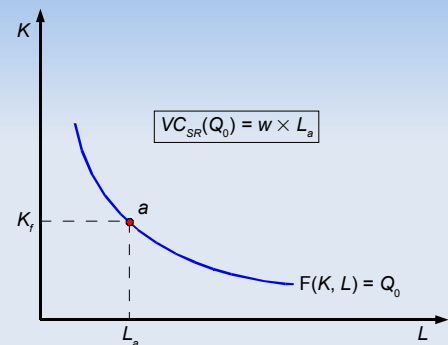
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Cost in the short run

- *Short run economic cost* = the minimal level of expenditures (measured in opportunity-cost terms) needed to produce a given amount of output in the short run
- In the short run, some factors are fixed (sunk costs) \Rightarrow no alternative uses \Rightarrow no economic costs \Rightarrow short-run economic cost entirely driven by the variable factor \Rightarrow *short-run variable cost*

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Short-run variable cost



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Other costs in the short-run

- *Short-run fixed cost* (FC_{SR}) = expenditures on factor that are fixed in the short run
- *Short-run total cost* (TC_{SR}) = sum of short-run variable and fixed costs
$$TC_{SR} = VC_{SR} + FC_{SR}$$
- Only short-run variable cost is an economic cost (remember that the economic cost of fixed inputs is zero) \Rightarrow only VC_{SR} matters in short-run decisions

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Short-run variable cost

- Properties:
 - must slope upward
 - level depends on the level of fixed factor (capital)
 - higher capital means lower short-run cost of labor (although it might sound counter-intuitive, remember it is because capital is fixed in the short run)

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Short-run marginal cost

- **Short-run marginal cost (MC_{SR})** = change in the short-run variable cost due to the production of one more unit of output (depends on technology)
- **Marginal factor cost (MFC)** = additional amount the firm has to pay for a factor when it hires one more unit of the factor
- One more unit of labor produces MPP_L more units of output \Rightarrow one unit of output is produced by $1/MPP_L$ units of labor \Rightarrow

$$MC_{SR} = \frac{MFC_L}{MPP_L}$$

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Marginal cost for a price taker

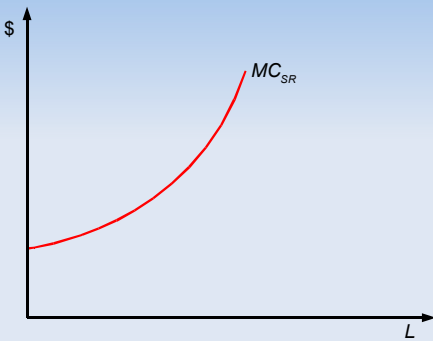
- Price taking firm \Rightarrow price of factors (wage) is not influenced by its demand (for labor) $\Rightarrow MFC_L = w$
- In this case, then:

$$MC_{SR} = \frac{w}{MPP_L}$$

- The higher the MPP , the lower the MC
 - diminishing MPP (of labor) $\Rightarrow MC_{SR}$ is upward sloping
 - increasing MPP (of labor) $\Rightarrow MC_{SR}$ is downward sloping

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Short-run marginal cost



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Average cost in the short run

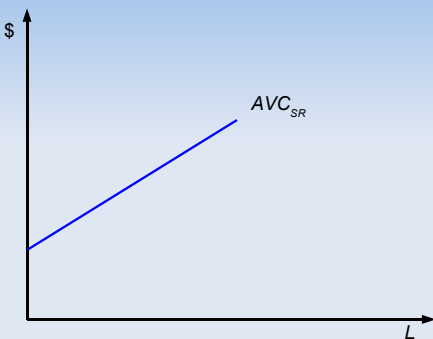
- **Short-run average variable cost (AVC_{SR})** = short-run variable cost per unit of output produced:

$$AVC_{SR} = \frac{VC_{SR}}{Q}$$

- Again, depends on marginal product:
 - increasing marginal returns $\Rightarrow AVC_{SR}$ is downward sloping
 - diminishing marginal returns $\Rightarrow AVC_{SR}$ is upward sloping

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Short-run marginal cost



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Other average costs

- **Short-run average fixed cost (AFC_{SR})** = short-run fixed cost per unit of output produced:

$$AFC_{SR} = \frac{FC_{SR}}{Q}$$

- **Short-run average total cost (ATC_{SR})** = short-run total cost per unit of output produced:

$$ATC_{SR} = \frac{TC_{SR}}{Q} = AVC_{SR} + AFC_{SR}$$

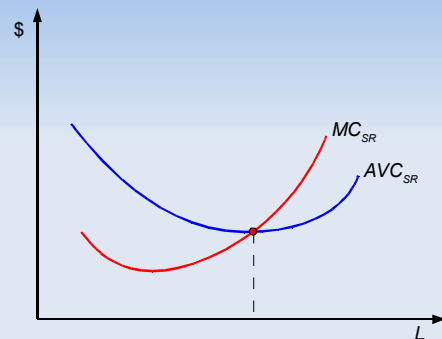
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Relationship between MC and AVC

- Since average variable cost and marginal cost are both derived from variable costs, they are related (hint: think of GPA):
 - when $MC_{SR} < AVC_{SR}$, AVC_{SR} falls
 - when $MC_{SR} > AVC_{SR}$, AVC_{SR} rises
- $\Rightarrow MC_{SR}$ crosses AVC_{SR} at the point where AVC_{SR} is at a minimum

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MC and AVC



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Cost in the long run

- In the long run, all factors are variable \Rightarrow expenditures on all factors are economic costs
- Also, firms can substitute among factors (since they are all variable)
- An input combination is *economically efficient* when it has the lowest opportunity cost among the input combinations that can be used to produce the desired output

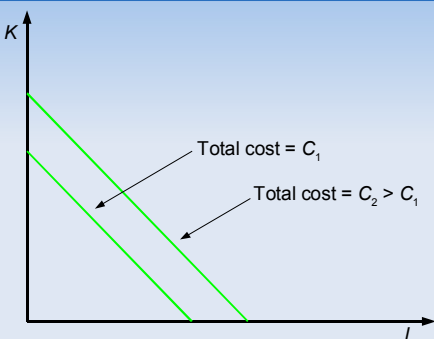
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Isocost lines and map

- Isocost line* = line representing all input combinations that cost the firm the same amount
- Isocost map* = set of all isocost lines that exist for a given set of factor prices
- Analogous to the budget line in utility theory (but a bit more complicated):
 - change in factor price tilts the line around the intercept for the *other* factor
 - no equivalent of "income limit"

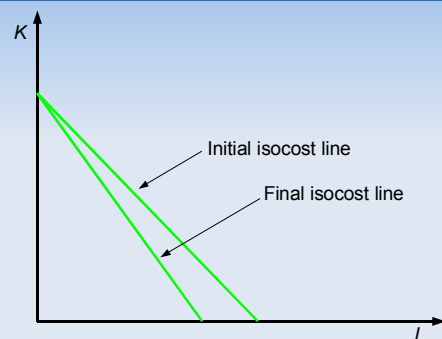
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Isocost map



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Effect of a wage increase



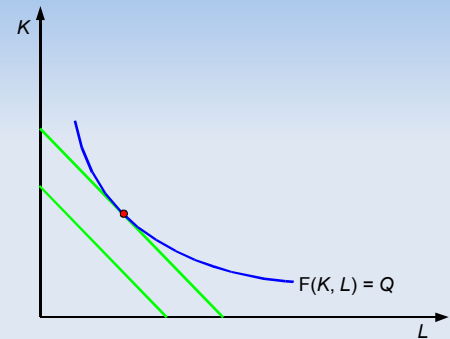
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The economically efficient input mix

- In utility theory, we combined the budget line with the indifference curves to obtain optimal consumption (consumer knew income)
- Here, we combine isocost lines with isoquants (firm knows production level)
- The difference is that what shifts around is the isocost line (the “budget constraint”)!
- Optimal mix of inputs: the tangency point

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The economically efficient input mix



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Algebraic interpretation

- At the optimum, isocost line and isoquant are tangent \Rightarrow slopes are equal:

$$MRTS = \frac{w}{r} \Rightarrow \frac{MPP_L}{MPP_K} = \frac{w}{r} \Leftrightarrow \frac{MPP_L}{w} = \frac{MPP_K}{r}$$

- A price-taking firm should operate at a point where, at the margin, the marginal products of the inputs are proportional to their prices
- Thus, a manager can determine the optimal input combination without needing to know the production function (just the MPP's)

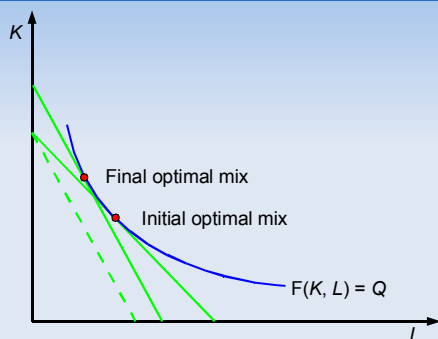
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Comparative statics

- Increase in factor price:
 - isocost line tilts \Rightarrow firm substitutes away from the factor whose price has risen
 - total cost must rise
 - reverse happens when factor price falls
- Better technology:
 - shift isoquant inward
 - lower total cost
- Better quality or higher output: can be interpreted as a more costly technology (outward shift of isoquant)

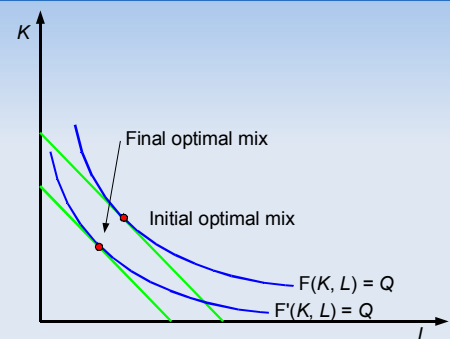
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Increase in wage



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Better technology



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Long-run costs

- *Long-run total cost* (TC_{LR}) = minimal level of total expenditures (measured in opportunity-cost terms) needed to produce a given level of output in the long run
- *Long-run marginal cost* (MC_{LR}) = the change in long-run total cost due to the production of one more unit of output
- *Long-run average cost* (AC_{LR}) = long run total cost per unit of output produced

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Long-run vs short-run costs

- Fixed factors:
 - short run: some factors are fixed \Rightarrow any expenditure on them is not an economic cost
 - long run: all factors are variable \Rightarrow no fixed costs \Rightarrow higher economic costs than in the short run
- Substitution of factors:
 - short run: not (fully) possible because of fixed factors \Rightarrow higher costs
 - long run: fully possible \Rightarrow lower costs
- In the end: long-run costs can be higher or lower than short-run costs

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Economies of scale and of scope

- *Economies of scale* = long-run average cost falls as output rises
 - production function has increasing returns to scale
 - when there are setup costs (have to be incurred regardless of how much output is produced)
- *Diseconomies of scale* = long-run average cost rises as output rises (e.g., decreasing returns to scale)
- *Economies of scope* = cheaper to produce two products in the same firm rather than in two specialized firms

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