Agenda

1. Types of Costs
2. Cost Minimization Problem
3. Comparative Statics
4. Short-Run Cost Minimization

Types of Costs

- **Explicit Costs** - Costs that involve a direct monetary outlay.
- **Implicit Costs** - Costs that do not involve outlays of cash.
- **Opportunity Costs** - The value of the next best alternative that is forgone when another alternative is chosen.
- **Economic Costs** - The sum of the firm's explicit costs and implicit costs.
- **Accounting Costs** - Total of explicit costs that have been incurred in the past.
- **Sunk Costs** - Costs that have already been incurred and cannot be recovered.

Types of Costs Examples

- Firm building factory
  - Before Factory is built
    - Explicit Costs
    - Implicit Costs
  - After Factory is built
    - Explicit Costs
    - Implicit Costs
    - Sunk Costs
- Opportunity Cost - Sum of Explicit and Implicit costs.

Cost Minimization Problem

- **Cost minimization problem** - The problem of finding the input combination that minimizes a firm's total cost of producing a particular level of output.

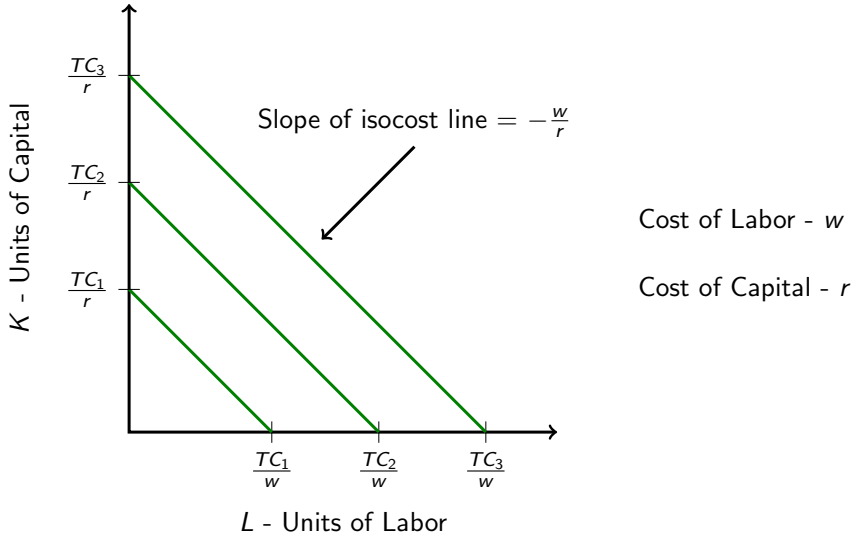
$$\min_{K,L} C(K, L)$$
$$\text{subject to } Q(K, L) = Q_0$$

- **Short Run** - Period of time in which at least one of the firm's input quantities cannot be changed.
- **Long Run** - Period of time long enough for the firm to vary the quantities of all of its inputs as much as it desires.

Isocost Lines

Definition (Isocost Line)

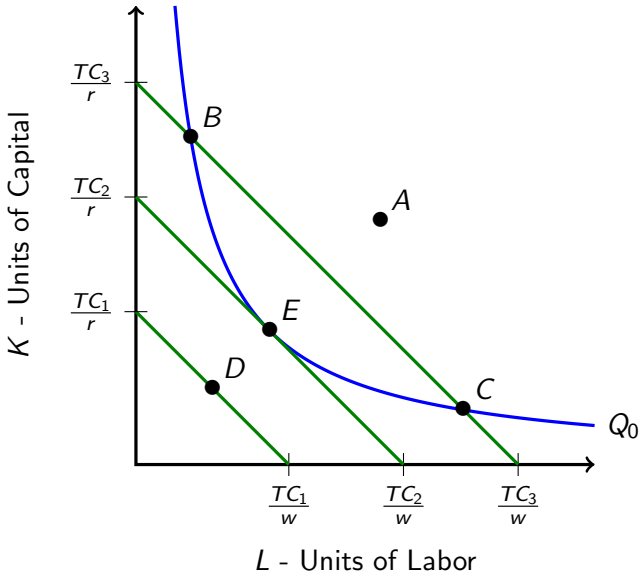
The set of combinations of labor and capital that yield the same total cost for the firm.



Long Run Cost Minimization Problem - Graphically

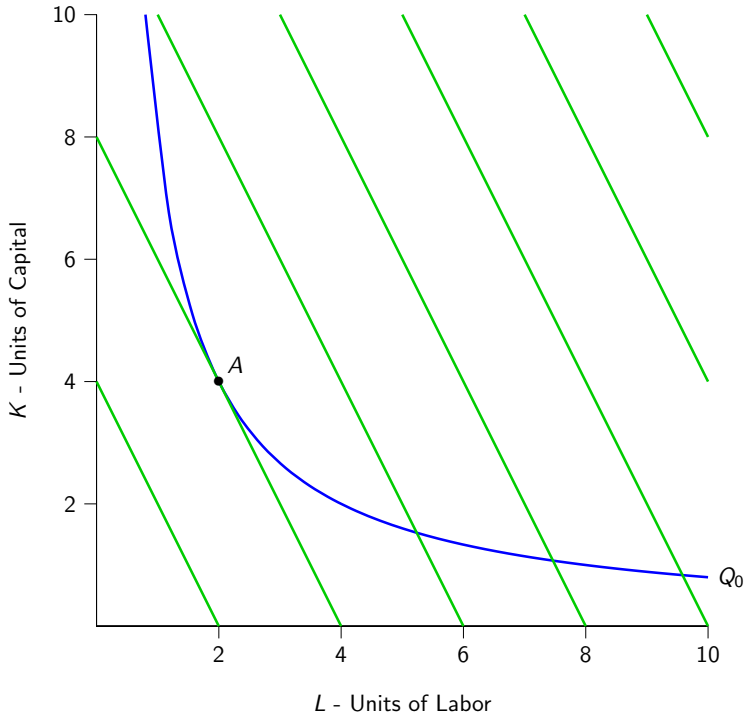
- Firm wants to produce Q_0.
- Long Run $\Rightarrow$ can adjust all inputs.
- Interior optimum ($L > 0$ and $K > 0$):

$$MRTS_{L,K} = \frac{MP_L}{MP_K} = \frac{w}{r} \quad \text{or} \quad \frac{MP_L}{w} = \frac{MP_K}{r}$$



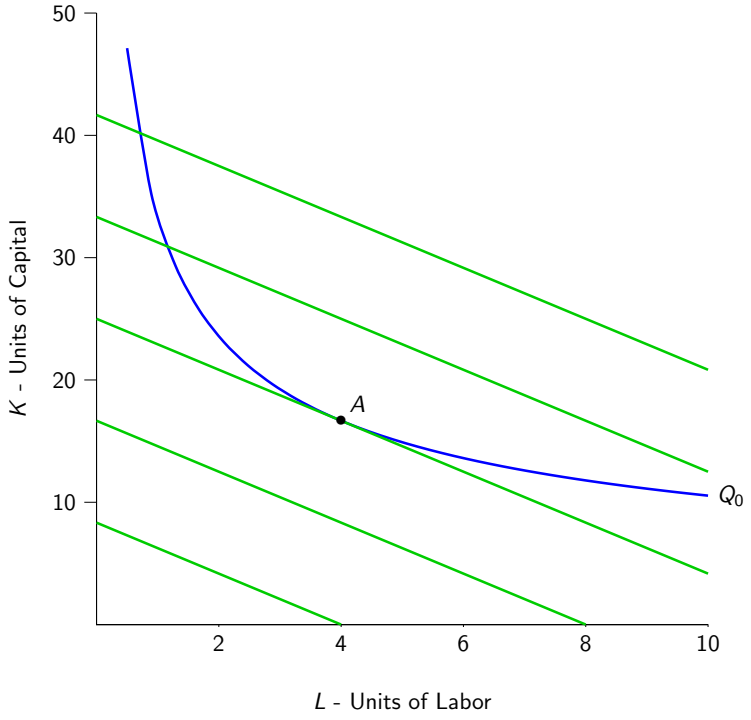
Long-Run Cost Minimization Example #1

- Production function: $Q(L, K) = 5LK$
- Production target: $Q_0 = 40$
- Prices: $w = 4$ and $r = 2$



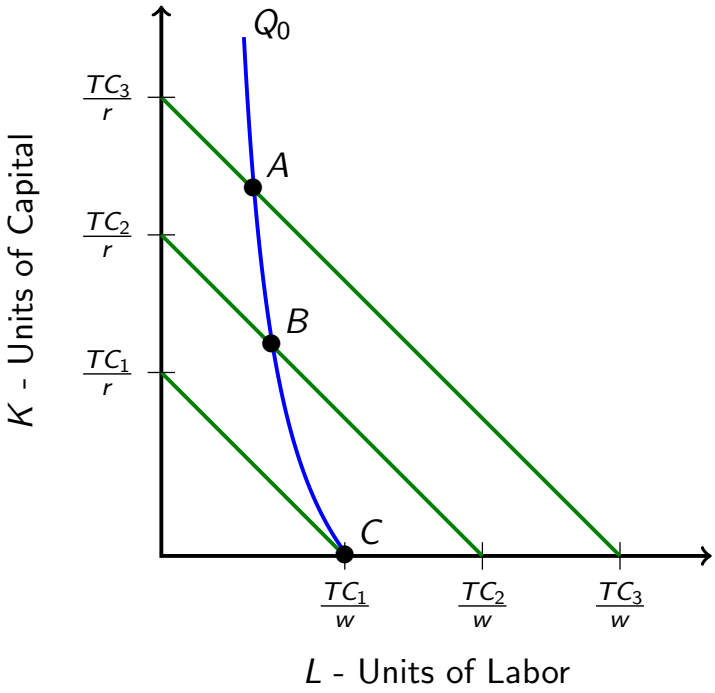
Long-Run Cost Minimization Example #2

- Production function: $Q(L, K) = 5LK$
- Production target: $Q_0 = 20$
- Prices: $w = 4$ and $r = 2$



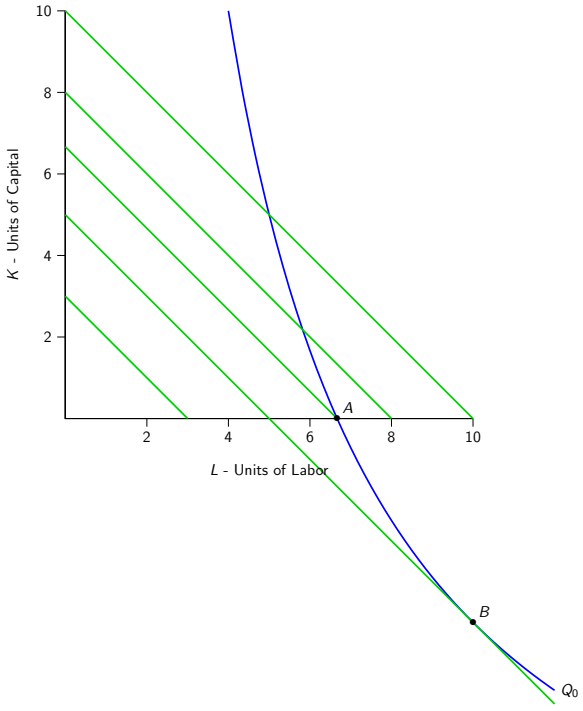
Long Run Cost Minimization Problem - Boundary Solution

- Firm wants to produce Q_0.
- Long Run $\Rightarrow$ can adjust all inputs.
- **Corner Point Solution**: Optimal Basket is all L or all K.
- Tangency condition not satisfied at corner.



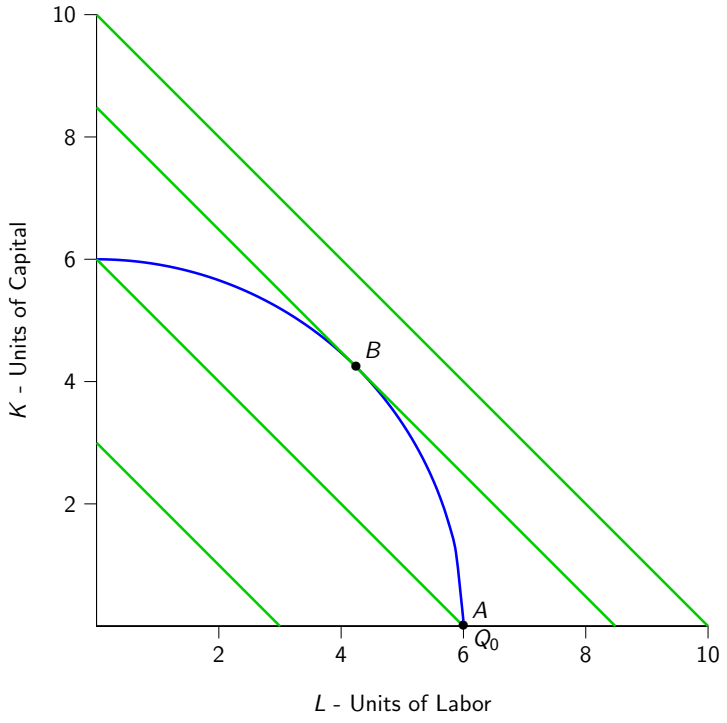
Long-Run Cost Minimization Example #3 - Corner Solution

- Production function: $Q(L, K) = LK + 15L$
- Production target: $Q_0 = 100$
- Prices: $w = 1$ and $r = 1$



Long-Run Cost Minimization Example #4 - Corner Solution

- Production function: $Q(L,K) = L^2 + K^2$
- Production target: $Q_0 = 36$
- Prices: $w = 1$ and $r = 1$



Long-Run Cost Minimization Summary

- How to find cost minimizing combination of labor and capital?
  1. Find point on isoquant that satisfies tangency condition.
     - Equation #1: Tangency Condition

$$\frac{MU_L}{MU_K} = \frac{w}{r}$$

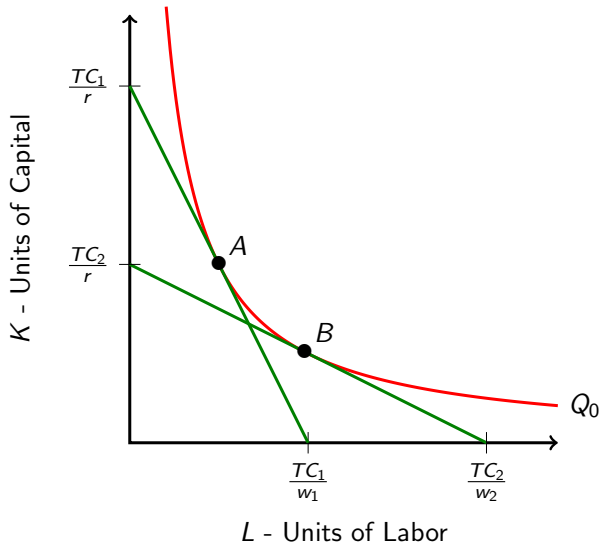
     - Equation #2: Isoquant for production target

$$Q(L,K) = Q_0$$

  2. Compare for corner solutions.
     - What is cost when $L = 0$ and $K = 0$.
- Only need to do #1 if Cobb-Douglas Production Function.

Comparative Statics - Change in Prices

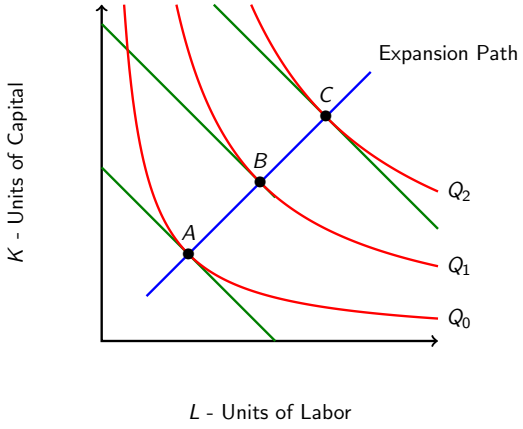
- Price of labor changes from w_1 to w_2.

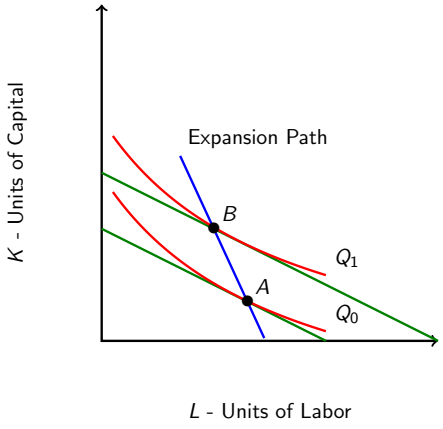


- With Diminishing $MRTS_{L,K}$, an decrease in $\frac{w}{r}$ leads to ___ capital and _____ labor.

Comparative Statics - Change in Output

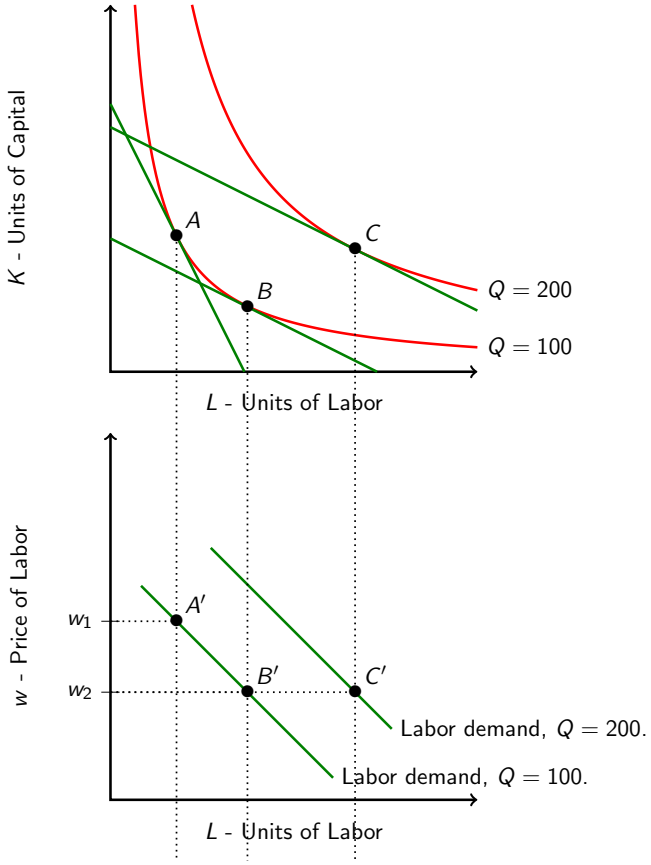
- **Expansion Path:** A line that connects the cost-minimizing input combinations as the quantity of output Q, varies, holding input price constant.
- **Normal input:** An input whose cost-minimizing quantity _____ as the firm produces more output.
- **Inferior input:** An input whose cost-minimizing quantity _____ as the firm produces more output.





Input Demand Curves

- **Input Demand Curve :** A curve that shows how the firm's cost-minimizing quantity of the input varies with the price of the input.
- Example: Labor Demand Curve
  - Vary price to find different quantities.
    - $w_1 \Rightarrow A$
    - $w_2 \Rightarrow B$
  - Larger quantities produced, lead to a shift outward of the input demand.



Price Elasticity of Demand for Inputs

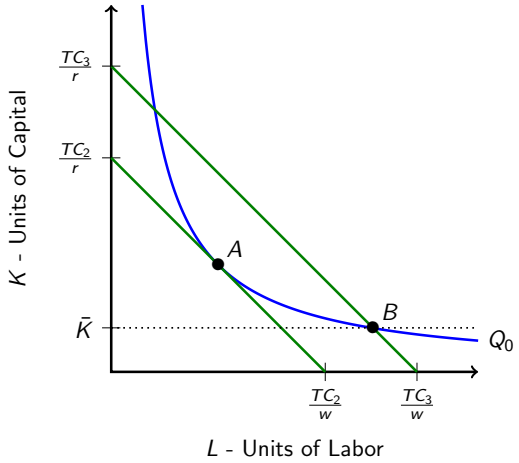
- **Price elasticity of demand for input:** The percentage change in the cost-minimizing quantity of input with respect to a 1 percent change in the price of the input.
- Example: Price elasticity of demand for labor:

$$\epsilon_{L,w} = \frac{dL}{dw}\frac{w}{L}$$

- Example: $L = Q^{1/2} r^{1/2} w^{-1/2}$

Short Run Cost Minimization Problem - Graphically

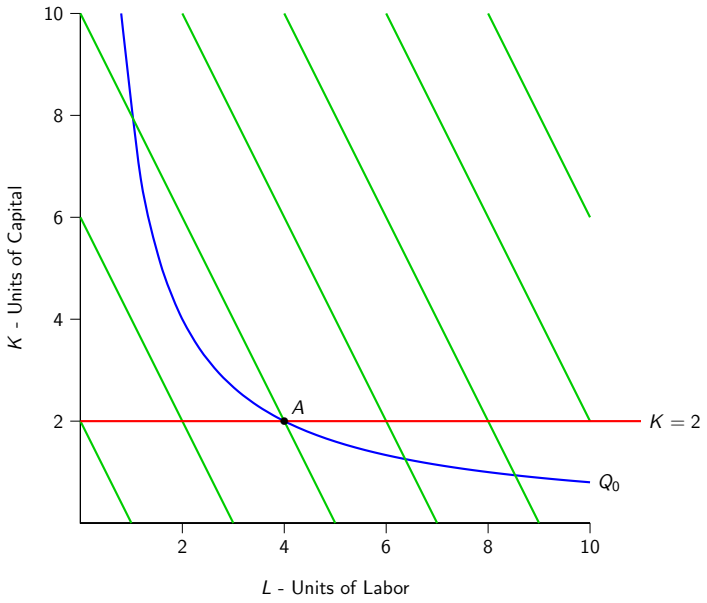
- Example: Fixed level $\bar{K}$, want to produce Q_0.



- A - Long run cost minimizing solution
- B - Short run cost minimizing solution

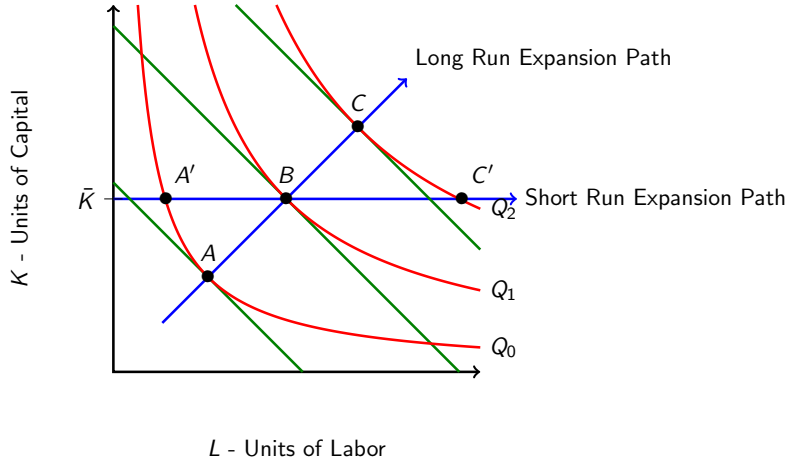
Short-Run Cost Minimization Example #1

- Production function: $Q(L, K) = 5LK$
- Production target: $Q_0 = 40$
- Prices: $w = 4$ and $r = 2$
- Stuck with $K = 2$



Comparative Statics - Change in Output

- Capital fixed at $\bar{K}$ in short run.



- **Long Run Expansion:** $A \rightarrow B \rightarrow C$
- **Short Run Expansion:** $A' \rightarrow B \rightarrow C'$

Short-Run Costs

- **Total Variable Cost:** The sum of expenditures on variable inputs, such as labor and materials, at the short-run cost-minimizing input combination.
- **Total Fixed Costs:** The cost of fixed inputs; it does not vary with output.
- Fixed vs. Sunk short-run costs:

	Fixed	**Variable**
Sunk	output insensitive unavoidable with $Q = 0$	Not Possible
Nonsunk	output insensitive avoidable with $Q = 0$	output sensitive avoidable with $Q = 0$

Exercise

- A firm faces production function $Q(L, K) = 20LK$.
  1. If $w = 1$ and $r = 2$, what is the cost minimizing input combination if the firm wants to produce 1000 units per year?
  2. Determine the demand curves for labor and capital (L and K as a function of Q, r, w).
  3. What if the firm is restricted to $\bar{K}$ units of capital in the short-run, what will their demand for labor be?

Solution

Solution

- Graphically