BUEC 280 LECTURE 9

Labour Demand

Assumptions

- firms maximize profits
- Firms are price-takers in all markets
- Technology
  - Two inputs: capital and labour
  - Production function: $Q=f(L,K)$
  - $\Delta Q/\Delta L = MPL>0$; $\Delta Q/\Delta K = MPK>0$
  - MPL is decreasing; MPK is decreasing

Labour demand in the short run

K is fixed; labour is the only variable input

Maximize profit: hire labour such that

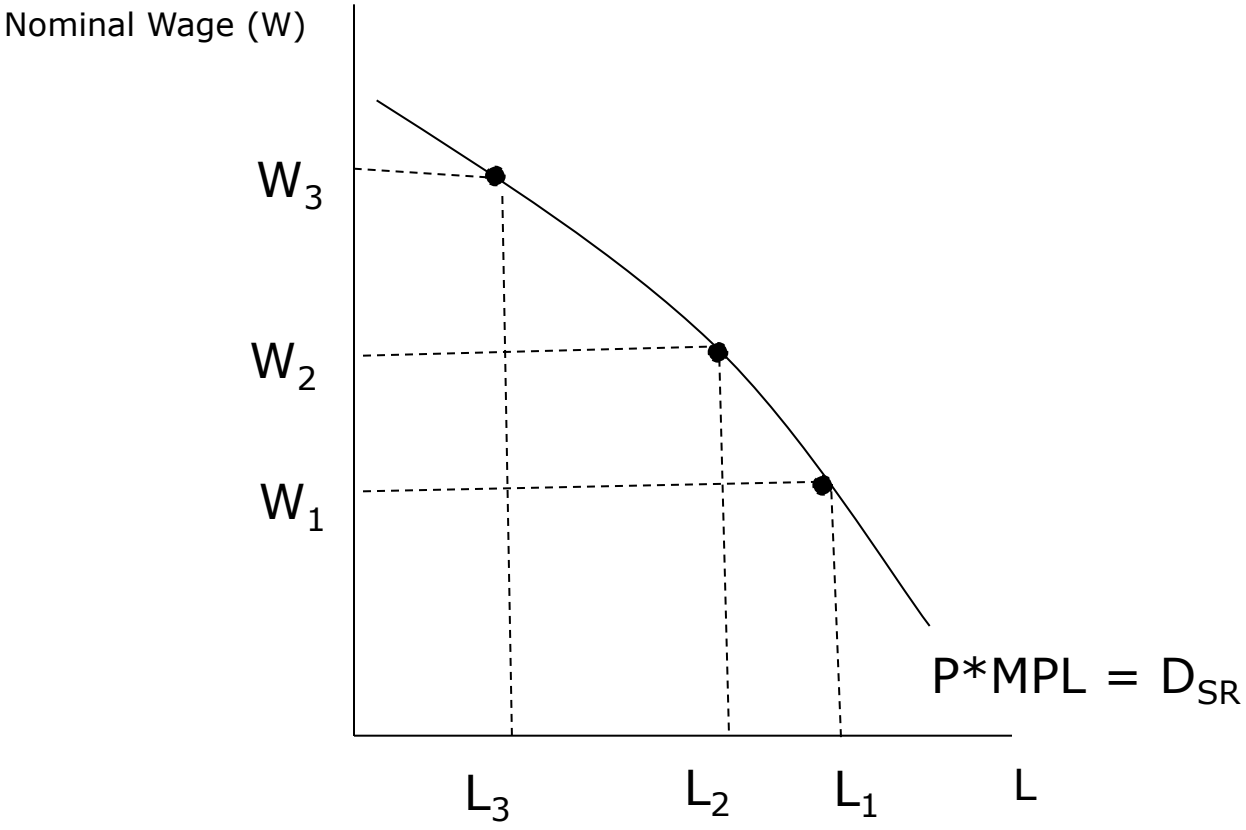
$$MC_L = MB_L$$

$$W = MR * MPL$$

$= P$ (MR)

diminishing (MPL)

The firm's short run labour demand



Labour demand in the long-run

- Firm can vary both capital and labour

- Two decisions:
  - How much output to produce?
  - What combination of L and K to use to produce that output?

  We will consider the second question first.

  For a given level of output, profit maximizing requires that the firm produce that output at the lowest possible cost – profit maximization requires cost- minimization

Isoquants

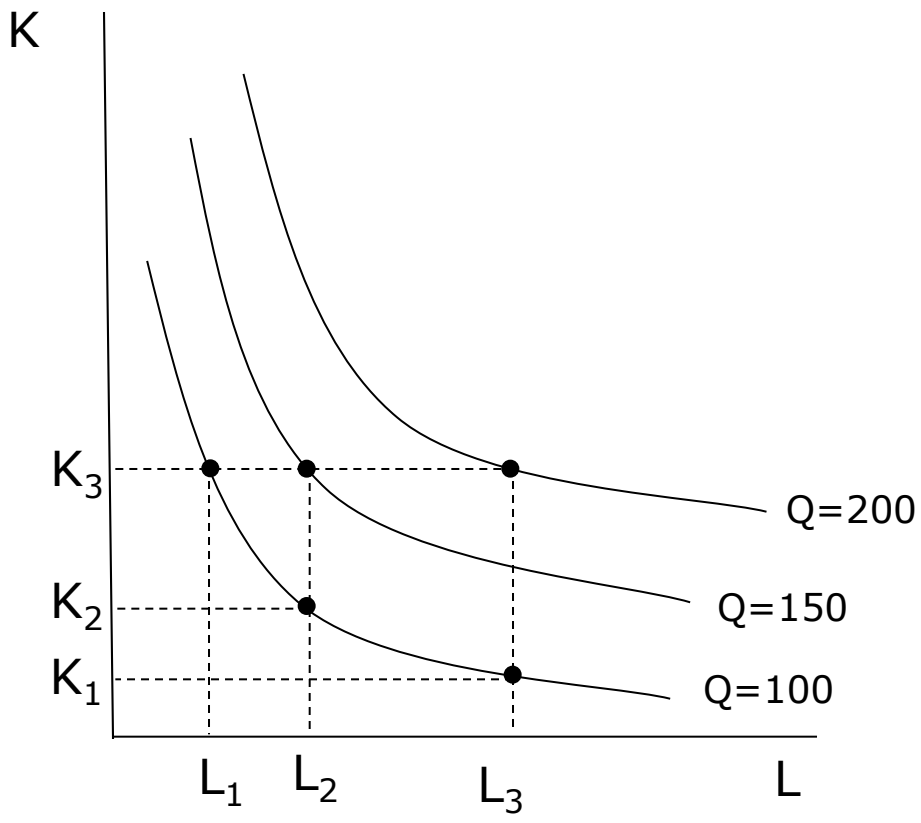
- The production function describes the technology that allows the firm to combine capital and labour to produce output.
- We represent the production function graphically with an **isoquant**
  - A curve that tells us all the different combinations of L,K that can be used to produce a given level of output, Q
- Think of it like an indifference curve
  - Instead of measuring different combinations of leisure & consumption that yield the same level of U, it measures combinations of L,K that can be used to produce the same level of output Q

An isoquant map

- Output is increasing as we move away from the origin (K and L are productive)
- Slope of isoquant =

  $-(\Delta K/\Delta L)|_Q$

If you reduce K by some amount, you must add L in order to maintain a constant level of output. So slope is negative



The marginal rate of technical substitution

- We call the slope of the firm's isoquant the **marginal rate of technical substitution** (MRTS)
  - Rate at which the firm can trade off capital and labour and hold output constant

$$MRTS = -(\Delta K/\Delta L)|_Q = -(1/(MPK/MPL)) = -(MPL/MPK)$$

  - By how much do we have to increase L if we reduce K?
  - If you reduce K by one unit, give up MPK units of output. Must add labour in the ratio of MPK/MPL

    e.g. if labour is twice as productive as capital at the margin, you have to add half as much labour to replace one unit of capital.

$$MRTS = -(MPL/MPK)$$

The marginal rate of technical substitution

$$MRTS = -(MPL/MPK)$$

MRTS is decreasing. Why?

- Diminishing marginal productivity of K and L
- If K/L is high, K is not very productive at the margin and L is very productive.
- Reduce K by one unit; don't need to increase L by very much.
- Isoquant is steep.
- MRTS = -MPL/MPK is big (in absolute value)

Costs

The isoquant map describes all the combinations of K and L that can be used to produce a given level of output.

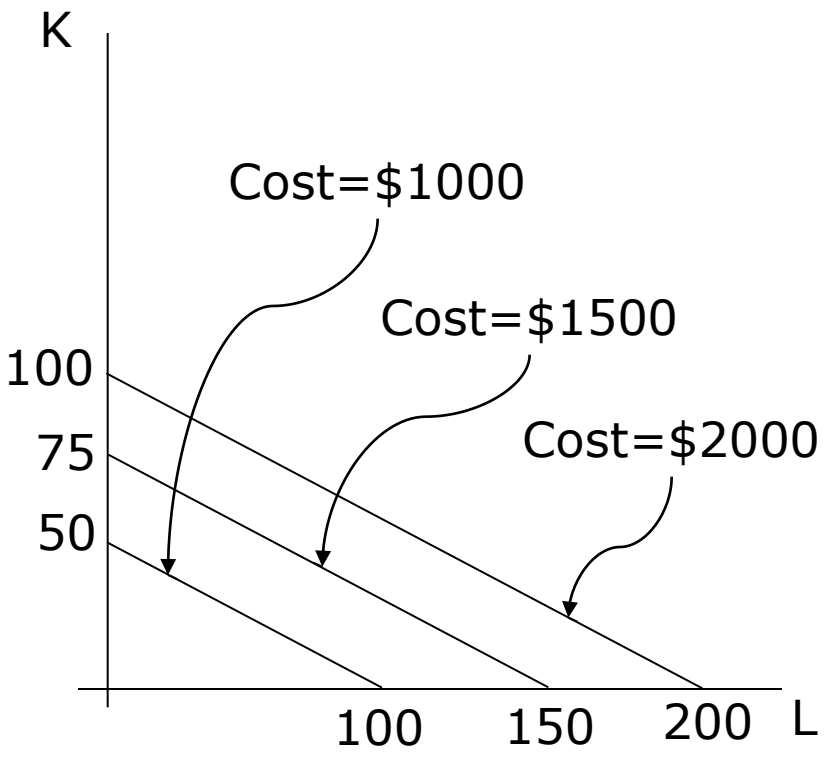
Which point should the firm choose?

In order to maximize profits, firm must minimize costs.

We can represent the cost trade-offs firms face when they make choices about K and L using an isocost map.

The isocost line

- The isocost line represents combinations of L,K that cost the same amount
- Suppose W = $10, r = $20
- Costs are constant along an isocost line. Suppose total cost is $1000.
- Firm can purchase 50 units of K and 0 units of L; or 100 units of L and 0 units of K.
- Higher total cost – more K, more L.



The isocost line

- What is the slope of the isocost line?

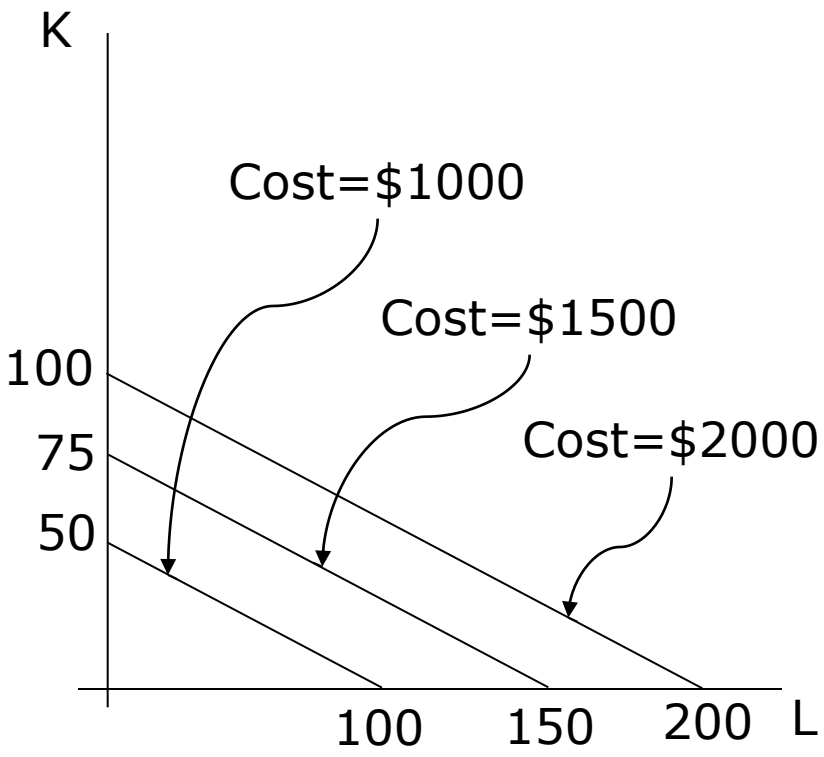
- $-(\Delta K/\Delta L)|_C$

If you purchase one less unit of K, you save r=20.

How many units of L can you buy?

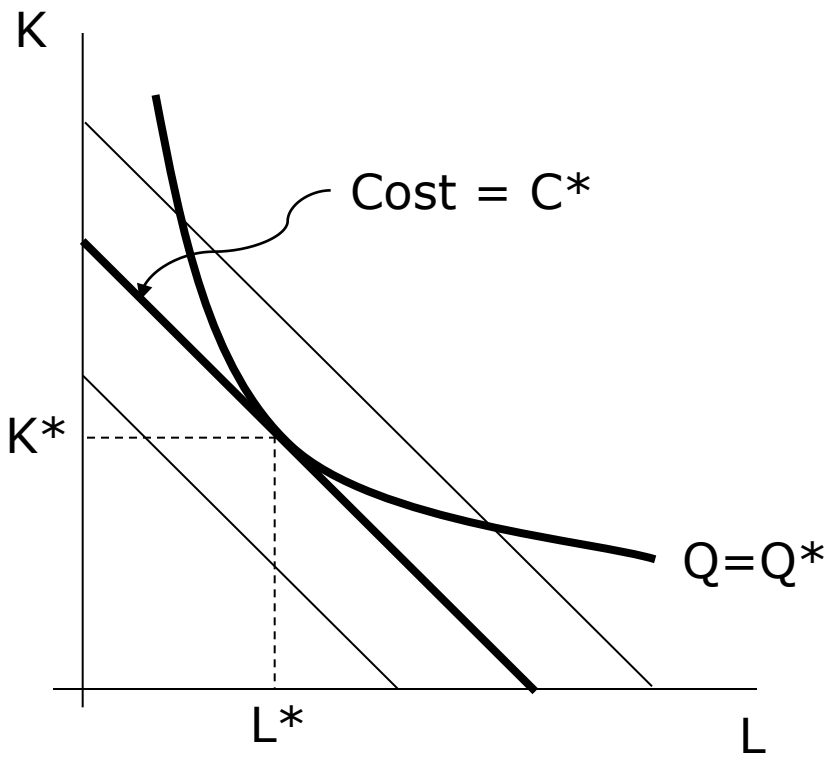
W=10, so you can buy 2 units of L.

Slope = -1/2 = -w/r



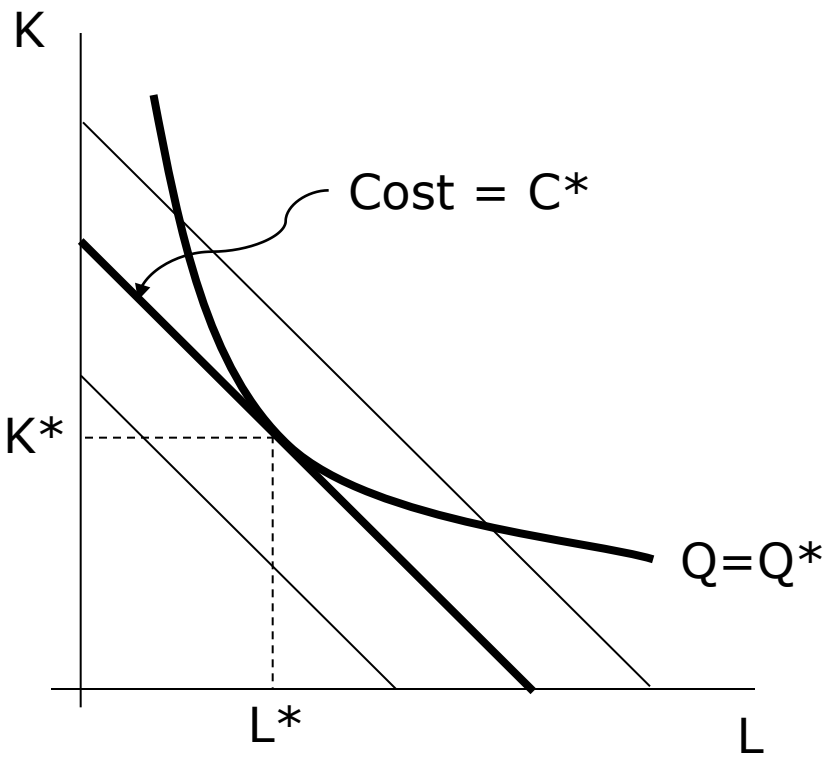
The cost minimization problem

- What combination of K and L should the firm employ to produce Q* units of output?
- The combination that minimize costs – that puts the firm on the lowest possible isocost line.
- This occurs at a *tangency* between the isoquant for Q* and an isocost line.



The cost minimization problem

- At the tangency point, the slope of the isoquant = the slope of the isocost
- W /r = MPL / MPK
- MPK /r = MPL / W
- Extra cost of producing 1 more unit of output using L = Extra cost of producing 1 more unit of output using K



Why is this profit maximizing?

- Our conditions is:
  - W / MPL = r / MPK
  - ⇨ Extra cost of producing 1 more unit of output using L = Extra cost of producing 1 more unit of output using K

- Suppose this equality didn't hold, so that W / MPL > r / MPK. This means
  - ⇨ Extra cost of producing 1 more unit of output using L > Extra cost of producing 1 more unit of output using K

- ⇨ The firm could reduce its use of labour and increase its use of capital, save money, and produce the same level of output
  - TO MAXIMIZE PROFITS, THE FIRM **MUST** MINIMIZE COSTS

Scale and Substitution Effects

- How do firms respond to changes in input prices?
- Suppose W increases
- Because labour is now more expensive relative to capital, and because labour and capital are substitutes in production, firms will change their input mix to use less labour and more capital to produce any level of output
  - This is a **substitution effect**
- Because it is now more expensive to produce any level of output, the firm will reduce output (and hence reduce use of labour (and probably capital too)
  - This is a **scale effect** (like an income effect in the leisure consumption choice model)

Scale and Substitution Effects Graphically

1. Wage is W_0, and firm chooses (L_0,K_0) to produce Q_0 units at cost C_0

2. Wage increases to W_1

Substitution effect:
(L_0,K_0) to (L_s,K_s)
[change in input mix due to higher wage, holding output constant]

Scale effect:
(L_s,K_s) to (L_1,K_1)
[change in inputs due to reduced output Q_1, because production is more expensive]
Note: we don't know Q_1