

# MICROECONOMICS II

## Topic 2 - Profit maximization

Julie Chytilová  
julie.chytilova@fsv.cuni.cz

# PROFITS

Profit = revenues minus costs

- ▶  $n$  outputs  $(y_1, \dots, y_n)$ ; prices  $(p_1, \dots, p_n)$
- ▶  $m$  inputs  $(x_1, \dots, x_m)$ ; prices  $(w_1, \dots, w_m)$
- ▶  $\pi = \sum_{i=1}^n p_i y_i - \sum_{i=1}^m w_i x_i$

Opportunity costs: factors of production valued at market price, even if not sold on the market. Earnings from the next best opportunity how to use them.

Economic definition of profit: all inputs valued at their opportunity costs.

# MAKING BIG MONEY BY NOT OPERATING YOUR BUSINESS, PUZZLE

Summer 2000, very high prices of electricity in California.  
Aluminum companies shut down and did very well.



# FIXED AND VARIABLE FACTORS OF PRODUCTION

Fixed factor: in a fixed amount for a firm

Variable factor: can be used in different amounts

Quasi-fixed factor: must be used in a fixed amount, but only when the firm produces positive output.

Short-run vs. long-run

- ▶ Some fixed factors in the short-run. All factors variable in the long-run.
- ▶ The least profit in the long-run is zero.
- ▶ In the short-run, the profit may be negative.

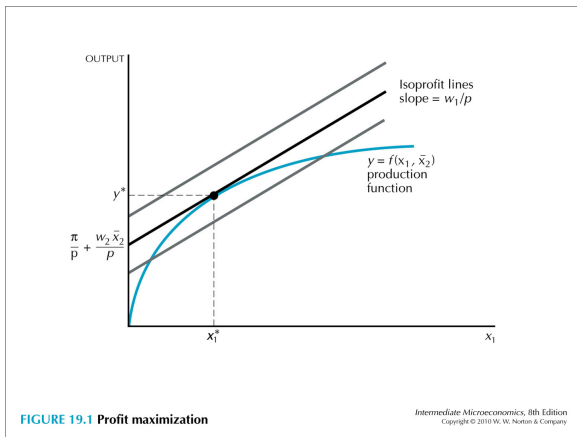
# SHORT-RUN PROFIT MAXIMIZATION

$$\max p f(x_1, \bar{x}_2) - w_1 x_1 - w_2 \bar{x}_2$$

First order condition

- ▶  $p \frac{\partial f(x_1^*, \bar{x}_2)}{\partial x_1} - w_1 = 0$
- ▶  $pMP_1 = w_1$
- ▶ The value of the marginal product of a factor equals its price.

# SHORT-RUN PROFIT MAXIMIZATION



$$\text{Isoprofit line } y = \frac{\pi}{p} + \frac{w_2}{p} \bar{x}_2 + \frac{w_1}{p} x_1$$

# SHORT-RUN PROFIT MAXIMIZATION

## Comparative statics

- ▶ Change in  $w_1$ : downward sloping factor demand curve
- ▶ Change in  $p$ : upward sloping supply function
- ▶ Change in  $w_2$ : no effect on the slope of the isoprofit line, intercept moves. No change in choice of inputs and output. Profit changes.

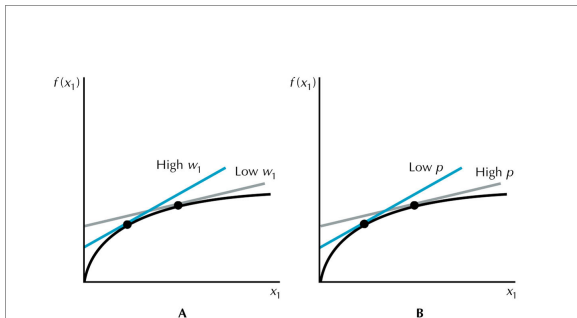


FIGURE 19.2 Comparative statics

# LONG-RUN PROFIT MAXIMIZATION

Optimizing more inputs simultaneously

$$\max p f(x_1, x_2) - w_1 x_1 - w_2 x_2$$

First order conditions:  $pMP_1 = w_1$  and  $pMP_2 = w_2$

Factor demand curves: optimal choice of factor as a function of the prices.

Inverse factor demand curves: what the factor price must be for certain quantity of factor to be demanded. Downward sloping (diminishing MP).

Solution of the profit-maximizing problem: factor demand functions and the supply function.



# LONG-RUN PROFIT MAXIMIZATION



## Exercise

Cobb-Douglas production function  $f(x_1, x_2) = x_1^a x_2^b$

Derive

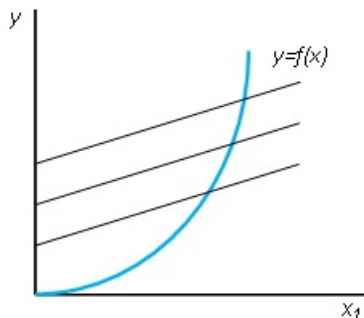
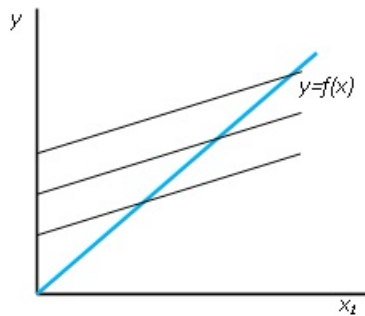
- ▶ Factor demand functions
- ▶ Supply function

# PROFIT MAXIMIZATION AND RETURNS TO SCALE

The only reasonable long-run profits for a competitive firm with constant returns to scale is zero.

- ▶ Constant or increasing returns to scale
  - ▶ Double all inputs: output doubles, profit doubles.
  - ▶ If profit was positive, the original choice was not optimal.
- ▶ Indefinite profit maximization
  - ▶ Eventually, decreasing returns to scale (coordination problems).
  - ▶ Large firm dominating the market (model of competitive profit maximization does not apply).
  - ▶ All firms expand output: price of output goes down and the profit as well.

# PROFIT MAXIMIZATION AND RETURNS TO SCALE



# REVEALED PROFITABILITY

The choice implies

- ▶ Inputs and output represent a feasible production plan
- ▶ The choice is more profitable than other feasible choices

## Weak axiom of profit maximization

- ▶ We observe two choices, at time  $t$  and  $s$
- ▶  $p^t y^t - w_1^t x_1^t - w_2^t x_2^t \geq p^t y^s - w_1^t x_1^s - w_2^t x_2^s$
- ▶  $p^s y^s - w_1^s x_1^s - w_2^s x_2^s \geq p^s y^t - w_1^s x_1^t - w_2^s x_2^t$
- ▶  $\Delta p \Delta y - \Delta w_1 \Delta x_1 - \Delta w_2 \Delta x_2 \geq 0$
- ▶ All comparative statics results

# REVEALED PROFITABILITY

From choices which satisfy WAPM, we can **construct an estimate of the technology**.

- Observe prices and choices in two periods: plot two isoprofit lines.
- More choices: tighter estimate

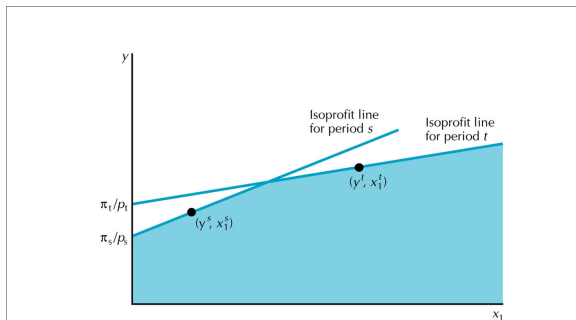


FIGURE 19.4 Construction of a possible technology

# EXAMPLE

Camerer, Babcock, Loewenstein, Thaler. 1997. *Quarterly Journal of Economics*. Labor Supply of New York City Cabdrivers.

- ▶ Theory: higher wage should lead to positive response in work hours
- ▶ Advantages: wage fluctuations on daily basis, choice of number of hours worked, relatively precise measures
- ▶ **Main finding:** drivers quit early on high wage days and drive longer hours on low wage days
- ▶ Importance of **psychological factors**
- ▶ **Potential explanation:** earnings target, one day time horizon
- ▶ The same number of hours every day  $\rightarrow$  5% higher earnings. As if the wage elasticity was +1  $\rightarrow$  10% higher earnings.