Intermediate Microeconomics (22014)

II. Producer Theory Applications

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Outline Part II. Produer Theory Applications

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TOPIC 0b. PRODUCER THEORY REVIEW

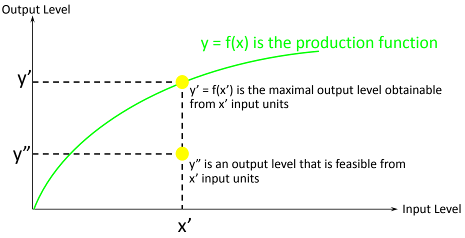
- How do firms decide how much product to supply? This depends upon the market environment, the firms' technology, their goals.
- Market environments:
  - ***Monopoly***: Just one seller that determines the quantity supplied and the market-clearing price.
  - ***Oligopoly***: A few firms, the decisions of each influencing the payoffs of the others.
  - ***Dominant Firm***: Many firms, but one much larger than the rest, which affects the payoffs of small firms.
  - ***Monopolistic Competition***: Many firms each making a slightly different product, each of them small relative to the total.
  - ***Pure Competition*****:** *Many firms, all making the same product, each of them small relative to the total. Firms have no influence over the market price for their product, they are price-takers.*

Production Function

Definitions

A ***technology*** is a process by which inputs are converted to an output. The technology's ***production function*** states the maximum amount of output possible, y, from an input bundle $(x_1, x_2, \ldots, x_n)$, $y = f(x_1, x_2, \ldots, x_n)$. The ***marginal product of input*** i is the rate-of-change of the output level as the level of input i changes, holding all other input levels fixed, $MP_i = \frac{\partial y}{\partial x_i}$.

One input, one output example



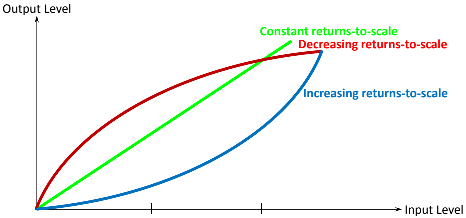
Returns to Scale

Definitions

Returns-to-scale describes how the output level changes as all input levels change in direct proportion (e.g. all input levels doubled, or halved). For any input bundle $(x_1, x_2, ..., x_n)$,

- if $f(kx_1, kx_2, ..., kx_n) = ky$, then we say the technology described by the production function f exhibits ***constant returns-to-scale,***
- if $f(kx_1, kx_2, ..., kx_n) < ky$, ***decreasing returns-to-scale,***
- if $f(kx_1, kx_2, ..., kx_n) > ky$, ***increasing returns-to-scale***.

One input, one output example



Iso-profit lines

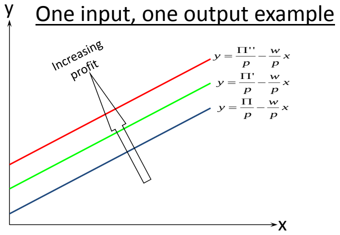
Definitions

The ***economic profit*** generated by the production plan $(x_1, \ldots, x_m, y_1, \ldots, y_n)$ is

$$\Pi = p_1 y_1 + ... + p_n y_n - w_1 x_1 - w_m x_m,$$

where $(p_1, ..., p_n)$ are product prices and $(w_1, ..., w_m)$ are input prices. A Π-***iso-profit line*** contains all the production plans that provide a profit level Π:

$$\{(y, x) : y \geq 0, x \geq 0, py - wx = \Pi\}$$

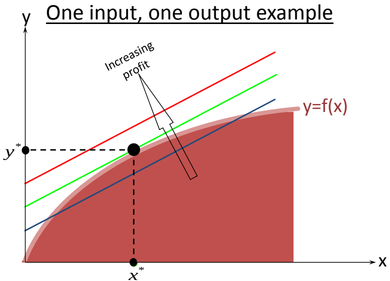


Profit maximization

Definitions

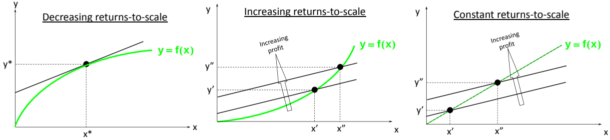
The ***competitive firm*** takes all output prices $p_1, \ldots, p_n$ and all input prices $w_1, \ldots, w_m$ as given constants. The ***profit maximization problem*** of the competitive firm is to locate the production plan that attains the highest possible iso-profit line, given the firm's constraint on choices of production plans. At the profit-maximizing plan, the slopes of the production function and the maximal iso-profit line are equal:

$$\underbrace{MP}_{\text{mg product}} = \frac{w}{p} \leftrightarrow \underbrace{p * MP}_{\text{mg revenue}} = w$$



Returns to scale and profit maximization

- If a competitive firm's technology exhibits ***decreasing returns-to-scale*** then the firm has a ***single*** long-run profit-maximizing production plan.
- If a competitive firm's technology exhibits exhibits ***increasing returns-to-scale*** then the firm has no profit-maximizing plan. So an increasing returns-to-scale technology is ***inconsistent*** with firms being perfectly competitive.
- If a competitive firm's technology exhibits ***constant returns-to-scale***, earning a positive economic profit is inconsistent with firms being perfectly competitive because if any production plan earns a positive profit, the firm can double up all inputs to produce twice the original output and earn twice the original profit. Hence constant returns-to-scale requires that competitive firms earn ***zero economic profits***.

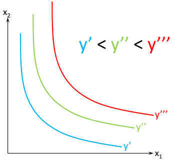


Isoquants

Definitions

The ***y-output unit isoquant*** is the set of all input bundles that yield the same output level y. The complete collection of isoquants is the ***isoquant map***, which is equivalent to the production function. The slope of an isoquant is its ***technical rate-of-substitution***, the rate at which input 2 must be given up as input 1's level is increased so as not to change the output level.

$$dy = \underbrace{\frac{\partial f(x_1, x_2)}{\partial x_1}}_{\equiv MP_1} dx_1 + \underbrace{\frac{\partial f(x_1, x_2)}{\partial x_2}}_{\equiv MP_2} dx_2 \Rightarrow TRS \equiv \frac{dx_1}{dx_2} = -\frac{MP_1}{MP_2}$$



Iso-cost lines

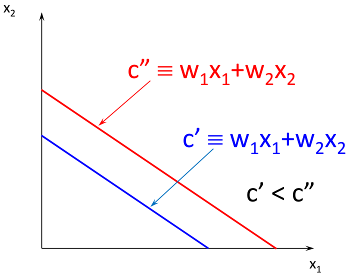
Definition

An ***iso-cost*** is a curve that contains all of the input bundles that cost the same amount:

$$w_1 x_1 + w_2 x_2 = c$$

$\Leftrightarrow$

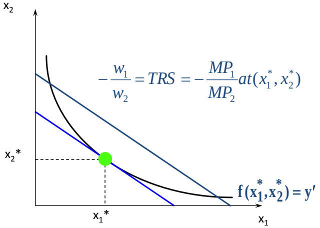
$$x_2 = \frac{c}{w_2} - \frac{w_2}{w_1} x_1 .$$



Cost Minimization

Definitions

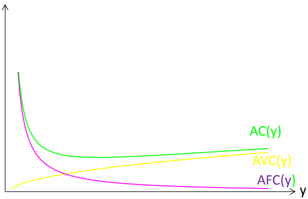
A firm is a ***cost-minimizer*** if it produces any given output level y at the smallest possible total cost. The ***total cost function*** of the firm, $c(w_1, w_2; y)$, denotes the firm's smallest possible total cost for producing y units of output. The ***conditional input demands***, $x_1^*(w_1, w_2; y)$ and $x_2^*(w_1, w_2; y)$, are the least-costly input bundle.



Cost Functions

Definitions

The firm's ***fixed cost function***, F, is the cost which does not vary with the firm's output level. The ***variable cost function***, $c_v(y)$, is the total cost to a firm of its variable inputs when producing y output units. The ***total cost*** of producing y is the sum of the fixed and variable costs: $c(y) = F + c_v(y)$. For positive output levels y, a firm's ***average total cost*** of producing y units is equal to the average fixed cost plus the average variable cost: $AC(y) = \frac{c(y)}{y} = \frac{F}{y} + \frac{c_v(y)}{y}$.

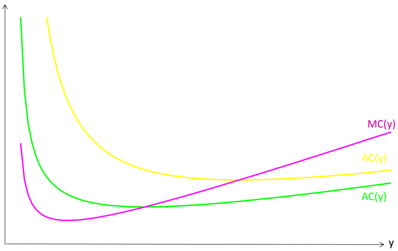


Marginal cost function

Definition

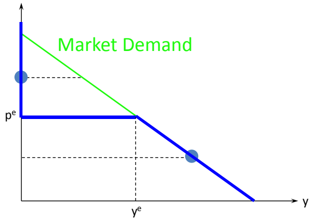
The ***marginal cost*** is the rate-of-change of the variable production cost as the output level changes: $MC(y) = \frac{\partial c_v(y)}{\partial y} = \frac{\partial c(y)}{\partial y}$. The marginal cost curve intersects both the average variable cost and the average cost curves from below each curve's minimum:

$$\frac{\partial AVC(y)}{\partial y} = \frac{\partial \frac{c_v(y)}{y}}{\partial y} = \frac{yMC(y) - c_v(y)}{y^2} = \frac{1}{y}\left(MC(y) - AVC(y)\right).$$



Firm's supply

- Demand curve faced by a competitive firm:
  - If the firm sets its own price above the market price then the quantity demanded from the firm is zero.
  - If the firm sets its own price below the market price then the quantity demanded from the firm is the entire market quantity-demanded.



- The individual firm's technology causes it always to supply only a small part of the total quantity demanded at the market price p^e.

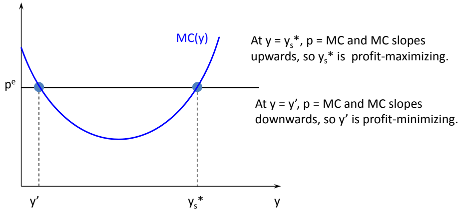
Firm's supply

- The supply function of a firm is the the upward part of the Marginal Cost curve.
  - Formally,

$$\max_{y} \Pi = py - c(y)$$

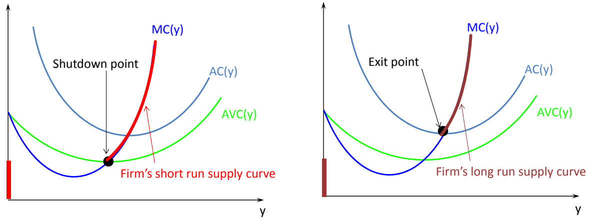
$$FOC : p - \frac{\partial c(y)}{\partial y} = 0 \Rightarrow MC(y^s) = p$$

$$SOC : -\frac{\partial^2 c(y)}{\partial y^2} \leq 0 \Rightarrow \frac{\partial MC(y^s)}{\partial y} \geq 0$$



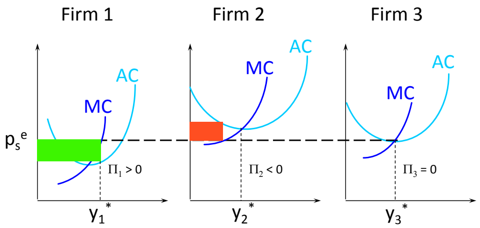
Firm's supply

- The short run supply curve lies above the AVC, since the producer surplus must not be negatve: $\Pi = py - F - c_v(y) \geq -F$.
- The long run supply curve lies above the AC, since the firm can exit the market so its economic profit level must not be negative: $\Pi = py - F - c_v(y) \geq 0$.



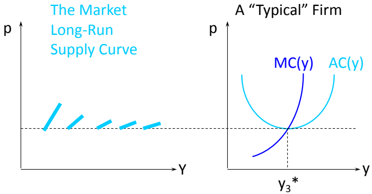
Industry supply

- In a competitive industry, every firm is a price-taker so total quantity supplied at a given price is the sum of quantities supplied at that price by the individual firms: $S(p) = \sum_{i=1}^{n} S_i(p)$.
- In the short-run, the number of firms in the industry is temporarily fixed since neither entry nor exit can occur. Consequently, firms may earn positive economics profits, suffer economic losses, or may earn zero economic profit.

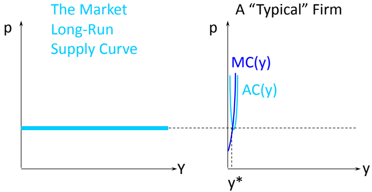


Industry supply

- In the long-run every firm now in the industry is free to exit and firms now outside the industry are free to enter.
- The long-run number of firms in the industry is the largest number for which the market price is at least as large as min AC(y).



Notice that the bottom of each segment of the supply curve is min AC(y).



As firms get "smaller" the segments get shorter. In the limit, as firms become infinitesimally small, the industry's long-run supply curve is horizontal at min C(y).

Monopoly and Monopoly Behavior

[TO BE ADDED SOON]

Game Theory and Oligopoly

[TO BE ADDED SOON]