Principles of Microeconomics 4

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Chapter 6
(Short Run and Long Run Production)

The economics of innovation in the bio-medical industry – MGT 403

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Short run / long run production

- **Short run**: Period of time during which the quantity of **at least one production factor is fixed**. => Changes in production can only be obtained by changes in the variable factors.

- **Long run**: Period of time (forecasting horizon) during which **all production factors are variable** (possible **to vary simultaneously the quantities of the two production factors**).

=> Concept of the **production function**: Relationship between the quantity produced of a good and the quantities of the different production factors involved in the manufacturing process of this good.

In what follows, we consider the simplified case where there are only **two production factors**, capital and labor.

- Q : quantity produced of the considered good (measured in terms of physical units)
- K : quantity of capital
- L : quantity of labor (measured in terms of services rendered during the period)

General expression of the production function:

$Q = F(K,L)$

Marginal product of each production factor: Defined as the additional output resulting from the use of an additional unit of this factor, the quantity of the other factor remains fixed.

Assuming the perfect divisibility of each production factor, we have:

$$MP_L = \frac{\partial F}{\partial L} = F_L^{'} \qquad \text{and} \qquad MP_K = \frac{\partial F}{\partial K} = F_K^{'}$$

It is supposed that the **marginal products are positive and decreasing** (decreasing marginal returns to factors), i.e.:

$$F_L' > 0 \text{ and } F_{LL}'' < 0 \qquad\qquad F_K' > 0 \text{ and } F_{KK}'' < 0$$

Average product of each production factor: Defined as the ratio between the quantity produced of the good and the quantity used of the production factor in question:

$$AP_L = \frac{Q}{L} \qquad and \qquad AP_K = \frac{Q}{K}$$

- Case of a production function with two factors: Possible to represent the **volume of production in the three-dimensional space**.

- Thus, we represent:

  - the quantity produced $Q = F(K,L)$ on the vertical axis,
  - the production factors K and L on the two other axis,

  so that the level of output is an increasing function of the two factors.

- For reasons of convenience, we cut the output area by horizontal planes, each plane representing a **certain level of output**.

- The level curves (contour lines) plotted are called **isoquants** (or **iso-product** curves). With a continuous production function, it exists an infinity of level curves, each representing a different level of output.
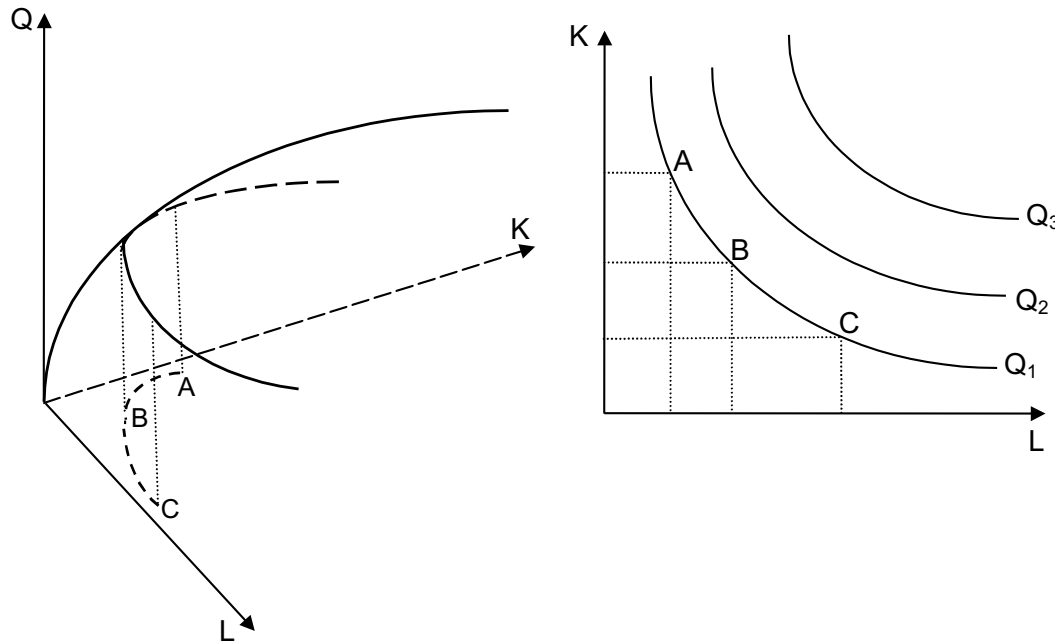
Returns to scale

It is said that there are **increasing** / **constant** / **decreasing** returns to scale when an increase in a certain proportion of the **amount of all factors** leads to an increase in a **larger proportion** / in the **same proportion** / in a **smaller proportion** of the **output level**.

- Increasing returns to scale: **economies of scale**
- Decreasing returns to scale: **diseconomies of scale**

Factors of scale economies

- Division of labor and specialization
- Technological factors
- Financial factors

To these factors of scale economies, we must oppose a factor of **diseconomy of scale** related to the existence of the **limits to an efficient organization**.

Note: The factors of scale economies and diseconomies are all active as **the size of the facility increases**. But while at first the factors of scale economies outweigh those of diseconomies of scale, **from a certain threshold, the relationship is reversed**.

=> The **long run average total cost** curve first decreases, reaches a minimum, and then increases.

Increasing returns and the new world of business (W.B. Arthur, 1996)

- **Assumption of diminishing returns**: products or companies that get ahead in a market run to limitations, so that a predictable equilibrium of prices and market shares is reached.

- Transformation from bulk-material manufacturing to design and use of technology – **from processing of resources to processing of information**.

- Shift **from diminishing to increasing returns**, generating not equilibrium but instability.

- Mechanisms of increasing returns exist alongside those of diminishing returns in all industries; but diminishing returns hold in the traditional part of the economy (**processing industries**), increasing returns reign in the newer part (**knowledge-based industries**).

- The two worlds have **different economics**: they differ in behavior, style, and culture; they call for different management techniques, strategies, and codes of government regulation.

The end of ownership: the zero-marginal-cost economy (D. Buytaert, 2014)

- **Sharing and collaboration practices of the internet** are extending to transportation (Uber), hotels (Airbnb), financing (Kickstarter), music services (Spotify), software development (Linux).

- Consumer «**sharing economy**»; by using collaboration, companies are dramatically reducing the production cost of their goods and services.

- The cost of a product can be divided into two parts: the «**setup cost**» (cost of assembling the team and tools needed to make the first unit) and the «**marginal cost**».

- For decades, competitive markets have focused on driving productivity up and marginal costs down, enabling businesses to reduce the price of their goods and services to compete against each other and win customers.

- Within service industries, new entrants are **succeeding not by optimizing production, but by eliminating production cost altogether**. See also: software industry (Open Source Software), automotive industry (Tesla).

- Capitalism is starting to become more collaborative rather than centered around individual ownership; great businesses can be built by adding value (e.g., on-demand services, support) on top of a low-marginal-cost community that is owned by many. => **Businesses will need to become much more open and collaborative to survive**.

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Capitalism is making way for the age of free (J. Rifkin, 2014)

- Millions of consumers have become **prosumers**, **producing and sharing** information, not only knowledge, news and entertainment, but also renewable energy, 3D printed products, and online college courses at near-zero marginal cost and nearly for free, shrinking revenues of the industries. => New economic paradigm: the **collaborative commons**.

- New communication technologies **reducing the marginal cost of producing and sending information goods to near zero**.

- Basic condition for **economic efficiency**: price = marginal cost; but if information goods are to be distributed at their MC of production (zero), they cannot be created/produced by firms that use revenues obtained from sales to consumers to cover their (fixed set-up) costs.

- Solution? **Government subsidies? Short-term monopolies?** – To artificially keep prices above marginal cost (i.e., the natural monopoly – while not meeting the basic condition for economic efficiency).

- Firms (e.g., Siemens, IBM, Cisco, GE) erecting an **internet-of-things infrastructure**, connecting the world in a global neural network. => Use of **big data** and analytics to develop predictive algorithms that can **speed efficiency, increase productivity and lower the marginal cost** of producing and distributing physical things to near zero.