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PRODUCTION EFFICIENCY AND MARKET CONSTRAINTS

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Abstract: *The present paper deals with optimization of production depending on input resources under market constraints. Production efficiency refers to increasing the output with a minimum input. The objectives of the management are: reducing costs of outputs simultaneously with reducing prices of market goods. This is a big challenge for each firm, in order to ensure quality with reducing costs per unit when the market "imposes" the price. Reducing the cost per unit depends on the optimal combination of resources: labor and capital. The paper presents a relation between market price evolution as a constraint and mixing of resources as a management priority. The paper's goal is to determine a relationship between the market demand on the one hand, through the demanded quantity Q_D and the market price P_u, and production expressed as mathematical function obtained by mathematical regression between realized quantity and resources consumed during the production process.*

Key words: *production, efficiency, variable inputs, costs, outputs, market price, optimal combination, resources*.

1. INTRODUCTION

Production is the most important component of economic activity; its main aim is to combine resources in order to provide high-quality and cost-effective products, goods or services.

The challenges of the 21st-century production are diverse, and not easy to anticipate; those involved directly or indirectly in production are forced to develop techniques and analysis methods which enable them to minimize negative effects.

Producers are constantly engaged in developing high-quality and cost-effective products. Modern technologies supported by the technical and technological advance of the last four decades help manufacturers develop complex products, with a minimum loss of resources – materials, raw materials and energy. The rate of present-day production seemed unimaginable years ago. Productivity has increased nowadays, production costs per unit being significantly lower than the actual delivery prices.

Competition, being the acknowledged motor for progress, brings huge benefits to consumers, enabling them to find high-quality products and purchase them for reasonable prices. On the other hand, competition is a permanent threat to companies, because of the emergence of less expensive products or substitution products on the market, Fig. 1 (D-demand, S-supply).

Any manufacturing company might find itself trapped between two markets: the resources market and end-products.

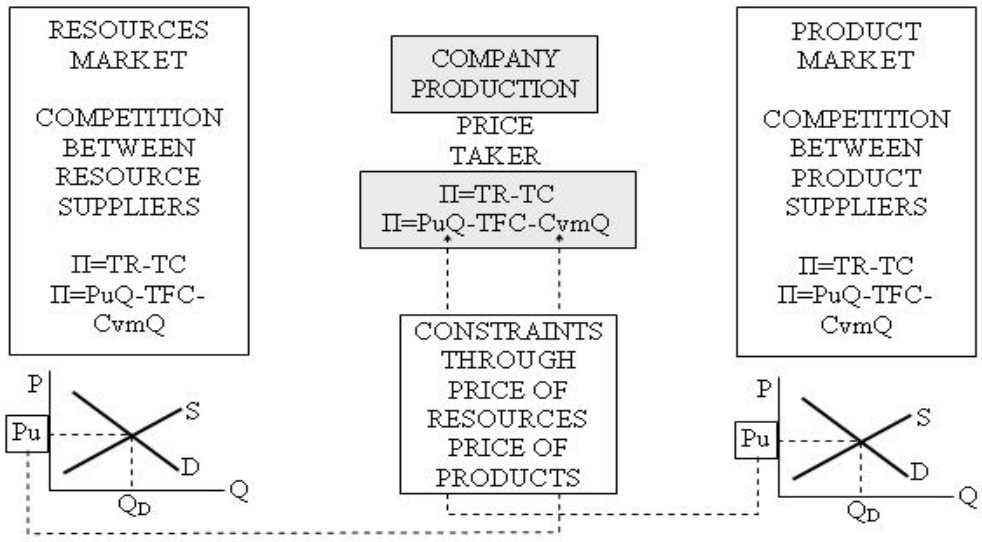


Fig. 1. The market constraints.

The market is a sum of constraints and threats to any manufacturing company participating in the products and services competition. As shown in Fig. 1, there is strong competition on the resource market; resource suppliers always target the higher price possible while buyers seek to purchase goods and services for the lowest price available. The competitors' behavior on the end-products market is basically similar: manufacturing companies target the highest price possible for their products, and buyers are constantly engaged in the search for the lowest price available.

The main objective of all players on the market is to obtain profit (Π). In all cases, the higher the difference between price (*Pum*) and average variable costs (*Cvm*), the higher the profit.

The profit, calculated as the difference between total revenue (*TR*) and total cost (*TC*), expression 1, is strictly dependent on TR and TC.

$$\Pi = TR - TC \quad (1)$$

Starting from expression 1 and developing costs according to the two categories, we obtain expression 2.

$$\Pi = PuQ - TFC - CvmQ \quad (2)$$

Total fixed costs (TFC) confirm the production capacity of the company and its facilities. Costs per unit depend on the manufacturing technology employed, on the innovation level. The quantity of products manufactured depends on the technological level of machine tools and production system and on the management.

Production, being a consumer of material, energy, human, information resources, has become increasingly dependent on the market. The resource market – where companies buy what is needed for the production process, for market prices set independently by those in charge with production management – is dynamic, permanently changing, expanding or contracting.

Producers require and expect suppliers to deliver the required quantity of resources and meet deadlines.

The limited character of resources, in our opinion, refers to the lack of the needed quantity of resources in the right place and the right time, and not to the resource depletion, such as for example the exhaustion of material resources.

The issue of using resources effectively is one of the points of interest for companies; it is known that, in the long run, profitability without efficiency may have negative effects on sustainability of the business. Efficiency refers to consuming the smallest amount of resources to produce the highest number of products.

2. CASE STUDY

As a competitor on the market, the company is a "PRICE TAKER"**,** who has to accept the price (*Pu*) set through competition. The price of resources is used for the calculation of consumptions per product unit, which determines the average variable expenditures (*Cvm*), Fig. 1, and thus resources price is one of the constraints imposed by the market.

On the product market, providing that competition is present, the price (*Pu*) is formed as a result of the meeting between demand *D* and supply *S*. The turnover and the profit of the company are dependent on the price level *Pu* and quantity *Q*, Fig. 2; this is the second market constraint.

As there is competition on the market of end-products, the price is set through the meeting of demand and supply; this price is valid for a well-determined period of time. The market also provides the quantity that is to be bought during the period when the balance $E_1 \ldots E_5$ is present (*E* is the point of intersection between demand and supply as shown in Fig. 2). For the balance E_5 (*Pu* = 9) the quantity required by the market is Q_5.

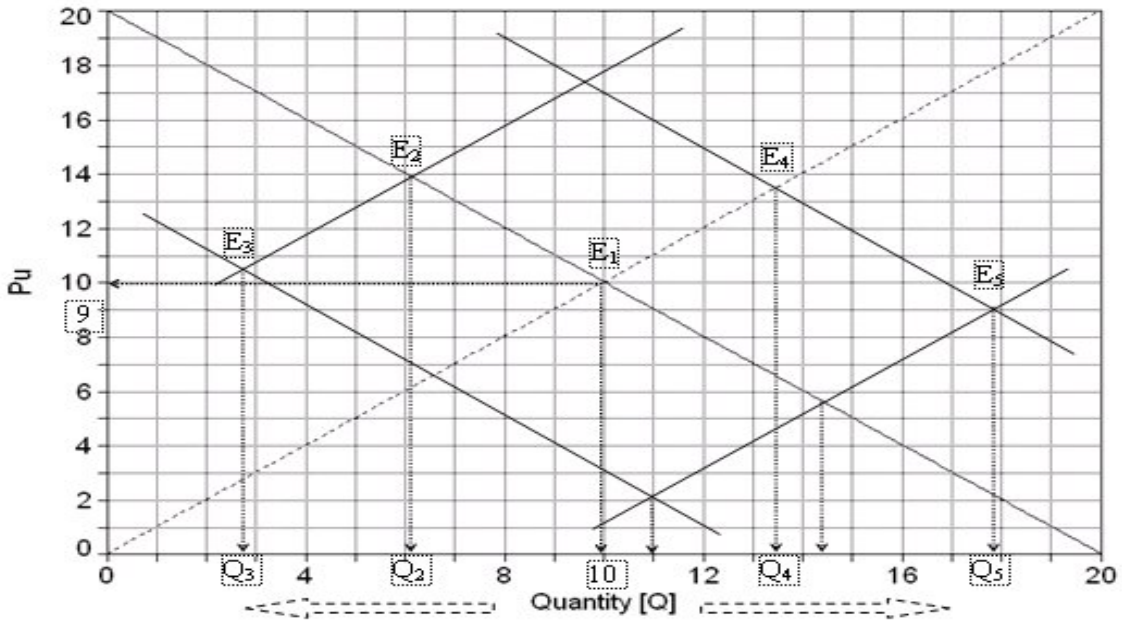


Fig. 2. The market game - Demand and supply.

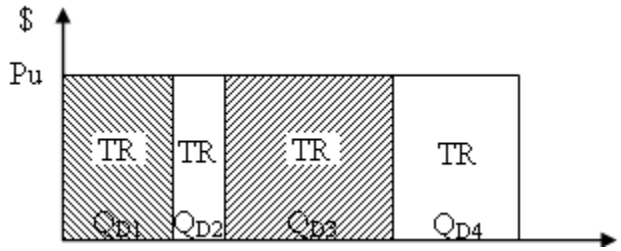


Fig. 3. Turnover for each firm.

The rate of turnover for one of the companies competing on the market will be a fraction of the PumQ_D, as shown in Fig. 3. Q_{Di} represents quantity demanded on the market.

The total quantity of the market will be:

$$Q_D=Q_{D1}+ Q_{D2}+ Q_{D3}+ Q_{D4}, \quad (3)$$

as the sum of quantities provided by each company. The quantity provided by each company depends on the production capacity.

Returning to expression 2,

$$\Pi=PuQ - TFC - CvmQ, \quad (4)$$

For one of the companies, under "price taker" conditions the turnover rate (*TR*) will depend on the production capacity. Company 1 will record a turnover rate PuQ_{D1}, company 2 PuQ_{D2}, company 3 PuQ_{D3} and company 4 PuQ_{D4}.

Total production function will be presented in correspondence with data from Table 1. The maxim production function value will be for 7 value of variable input (*VI*), Fig. 4.

The production function is given by polynomial multiple regressions using "Table curve editor" or other similar software.

Table 1

Total production function data

Variable inputs (*VI*)	Total production (Q_T)
1	29
2	70
3	117
4	164
5	205
6	234
7	245
8	232
9	189

The value for variable inputs from Table 1 is increasing by 1 because we consider in these example variable inputs represents labor.

Labor as resource in practical situation may be divided in fractional value.

Based on data from Table 1 production function will be: $Q = 21X + 9X^2 - X^3$, Fig. 4, where *X* (mathematical symbol) represents variable inputs. By generalizing, we obtain the production function as third degree polynomial function:

$$Q = aX+bX^2+cX^3, \quad (5)$$

where *a*, *b* and *c* represent regression coefficients.

Production efficiency will subsequently refer to reducing average unit costs (*Cvm*). As shown before, variable unit costs may be reduced through the implementation of new technologies and better management.

Starting from software modeled production based on discrete data according to the table below where *VI* is the variable input (labor), Q_T - total production, *MP* marginal production and *APvi* average production for the input variable, we obtain the graph in Fig. 4.

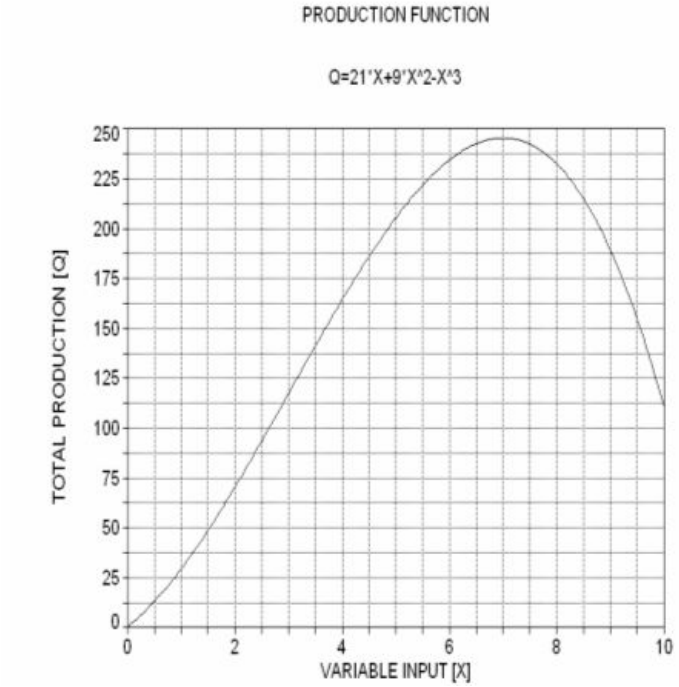
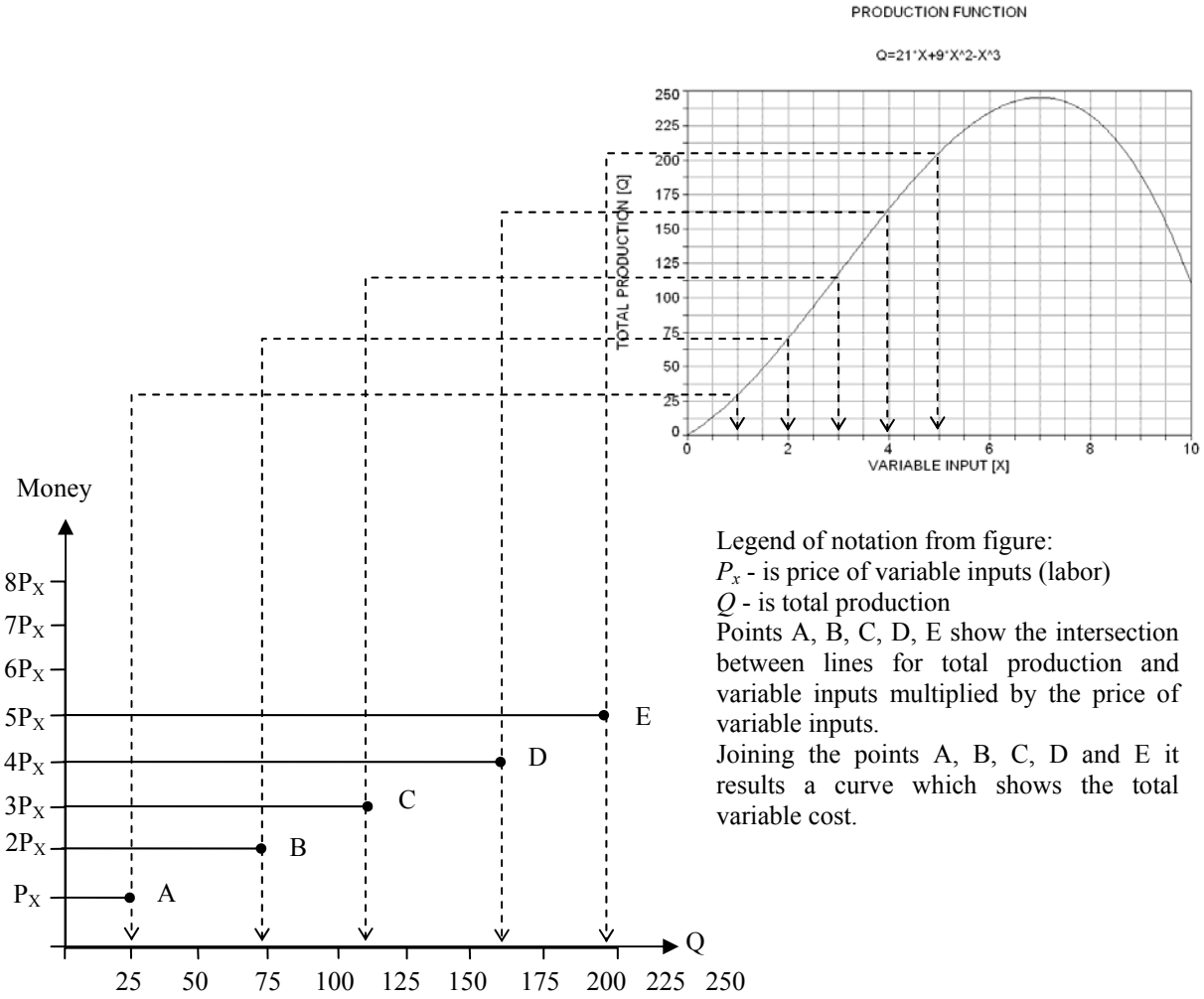


Fig. 4. The model of production function.



Legend of notation from figure:
P_x - is price of variable inputs (labor)
Q - is total production
Points A, B, C, D, E show the intersection between lines for total production and variable inputs multiplied by the price of variable inputs.
Joining the points A, B, C, D and E it results a curve which shows the total variable cost.

Fig. 5. Production function and total variable costs.

When each input variable unit has the same value *Px* accomplishing graphical correspondence, we obtain the evolution curve of variable costs.

There is a leveling tendency of variable costs, up to a value of total production due to the fast increase of production for the same input variable, Fig. 5.

3. CONCLUSIONS

Optimization of production implies a modeling a production function depending of variable inputs labor or capital.

As a mathematical function, production depends on input variables, i.e. the used resources.

By establishing a connection between total production and variable costs, one can determine the value of total production and implicitly the minimum costs for a certain number of input variables.

The minimum cost represents a measure of efficiency in comparison with market price.

Efficient use of resources implies concurrently considering the market development, by analyzing the prices it imposes, as well as combining resources in order to reduce production costs.

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