**Economics of the firm**

A firm is an organization of factors of production brought together to produce output

Factors of Production: Land, Labor Capital

The resources firms employ are scarce

What defines scarcity?

Firms Motivation: The only motivation we will study is profit maximization

Name other motivations for a firm?

Maximizing profit is constrained by,

1. Market conditions for output

2. Firm’s cost structure, determined by production function

**Production Function**

Illustrates relationship between inputs and output

Reflects technology (firm’s knowledge on how to put inputs together)

Firm’s production function partially determines its behavior in the marketplace

Suppose firm produces output Q utilizing capital (K) and labor (L)

Example of production function:

**Q = F(K,L) = 2KL** (note: something is wrong with this production function)

Q - weekly output, L - manhours per week

K – weekly hours of use of equipment (machine-hours)

Notes:

1. Production function is flow concept

2. Production functions (unlike utility functions) are directly measurable,

Q, L, K are not abstract

3. Production function illustrates idea that there is more than one method to produce output

Methods to produce: Q=8, 12, 20 (look at [table of production function](http://milesfinney.net/410/handout/prodfun.pdf))

**Marginal Product of an Input**

Additional output that can be produced by employing one more unit of an input, holding other inputs constant

MPL – Marginal Product of Labor

For the production function: MPL = $\frac{∂Q}{∂L} $= 2K

In the [table](http://milesfinney.net/410/handout/prodfun.pdf), what happens if K is fixed at 5 and L marginally changes?

Interpret MPL with K=5

**Law of Diminishing Returns**

Other inputs held constant, the productivity of the variable input must eventually begin to diminish (examples: flower pot, CSULA)

Short run concept

More realistic production function: **Q = F(K,L) = K1/2L1/2**

MPL = $\frac{∂F(K,L)}{∂L}$=1/2K1/2L-1/2= $\frac{1}{2}\sqrt{\frac{K}{L}}$

MPK = $\frac{∂F(K,L)}{∂K}$=1/2K-1/2L1/2= $\frac{1}{2}\sqrt{\frac{L}{K}}$

Relate calculated MPK and MPL to law of diminishing returns:

$\frac{∂MP\_{L}}{∂L}$ = -1/4 K1/2L-3/2 < 0

MPL continuously diminishes with L, but MPL itself is always positive

The same can be said for MPK

MPL

L

(interpret $\frac{∂MP\_{L}}{∂K}$ and $\frac{∂MP\_{K}}{∂L}$)

Productivity is commonly used to refer to average product

**APL – Average Product of Labor**

APL = $\frac{Q}{L}$

Production Function: F(K,L) = K1/2L1/2

APL = $\frac{K^{1/2}L^{1/2}}{L}$ = $\sqrt{\frac{K}{L}}$

For our production function, average product is twice the marginal product.

[Diagram of total and marginal product](http://milesfinney.net/410/handout/marginal_product.jpg).

With Production Function: F(K,L) = K1/2L1/2, identify ways firm can produce Q=10

|  |  |  |
| --- | --- | --- |
| **Point** | **K** | **L** |
|  | 1 | 100 |
| **B** | 5 | 20 |
|  | 10 | 10 |
| **A** | 20 | 5 |
|  | 25 | 4 |
|  | 100 | 1 |

**Isoquant** – set of input combinations that yield a given level of output

Capital

Labor

20

5

10

20

5

10

Q10

Q’

A

B

Output held constant along isoquant

Firm may produce Q=10 at any point along Q10 isoquant

The input mix the firm chooses will depend on relative input prices

(What is output level of Q’?)

**Marginal Rate of Technical Substitution:**

Rate at which firm can substitute between inputs, holding output constant

It is the slope of the isoquant

MRTSL,K = $\left.\frac{-∆K}{∆L}\right|\begin{matrix}\\Q\_{0}\end{matrix}$= $\frac{MP\_{L}}{MP\_{K}}$ [derive by taking total differential]

MRTSL,K is a function of input marginal products

MRTSL,K normally diminishes as move down isoquant

For our production function:

MRTSL,K = $\frac{MP\_{L}}{MP\_{K}}$ = $\frac{1/2K^{1/2}L^{-1/2}}{1/2K^{-1/2}L^{1/2}}$ = $\frac{K}{L}$

 = 4 at point A

 = ¼ at point B (interpret)

Point A: firm producing output with relatively large amount of capital; easier to forego capital for labor (example: teaching with technology)

$\frac{∂MRTS\_{L,K}}{∂L}$ = $\frac{-K}{L^{2}}$ < 0 which indicates diminishing MRTS as move down isoquant (L getting larger)

**Returns to Scale**

What happens to relationship between inputs and outputs when the scale of operation changes?

Long run concept

**Increasing Returns**

Proportional increase in all inputs yields a more than proportional increase in output

**Constant Returns**

Proportional increase in all inputs increases output by an equal proportion

**Decreasing Returns**

Proportional increase in all inputs yields a less than proportional increase in output

Production Function: **Q = F(K,L) = K1/2L1/2**

Suppose K and L increase by common factor (by 2 for example)

F(2K,2L) = (2K)1/2(2L)1/2

 = 21/2 · 21/2 K1/2L1/2

 = 2 K1/2L1/2

 = 2 Q

Doubling both inputs doubles output - **Constant Returns**

What are the returns to scale for these functions?

Q=K3/4L1/2 Q=K1/3L1/2

Reasons for increasing returns: division of labor, resources etc.

Reasons for decreasing returns: managerial oversight

What is difference between law of diminishing returns and the concept of decreasing returns to scale?

[Problems on opportunity cost](http://milesfinney.net/410/handout/oppcost.htm)

[Questions on the Economics of the Firm I](http://milesfinney.net/410/lecture/The%20Firm%20I.docx)

[Questions on the Economics of the Firm II](http://milesfinney.net/410/lecture/The%20firm%20II.docx)