

Properties of production function

- Production function:

$$Q = f(K, L)$$

Holding L fixed, Q is increasing in K .

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- Long run - all factors of production variable including going in or out of business.
- Short run - at least one factor of production is fixed.
No entry or exit.

- Short run production with K fixed. One variable input L .
- Show total output as a function of L .
- Increasing and then diminishing returns to L . Why?
- Average product of L ,

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

- Marginal product of L ,

$$MPL = \frac{\Delta Q}{\Delta L}$$

- MPL intersects APL at the highest point of APL .

- Technological improvement - For the same K , L , can produce more. This is a shift in production function. E.g.:

$$Q = af(K, L)$$

- Malthus was wrong. World food prices falling in spite of increasing population.
- Labor productivity increasing over time due to increase in K and increase in technology, a .

- Variable factors of production. Definition of isoquant: Combinations of K and L needed to produce a specific quantity of output.

$$f(K, L) = Q$$

- Marginal rate of technical substitution:

$$MRTS = -\frac{\Delta K}{\Delta L} = \frac{MPL}{MPK}$$

Derivation:

$$\Delta Q = MPK * \Delta K + MPL * \Delta L$$

On an isoquant, $\Delta Q = 0$ implies:

$$\begin{aligned} MPK * \Delta K + MPL * \Delta L &= 0 \\ -\frac{\Delta K}{\Delta L} &= \frac{MPL}{MPK} \end{aligned}$$

- What should shape of isoquant look like?
- Diminishing *MRTS*
- Perfect substitute
- Perfect complement

- Returns to scale:
- Increasing returns to scale. Why? E.g.?
- Constant returns to scale. Why? E.g.?
- Decreasing returns to scale. Why? E.g.?
- Why not one giant firm in each industry?