14.01 Principles of Microeconomics, Fall 2007
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Lecture 14

The Cost of Production and Profit Maximization

Outline

1. Chap 7: *Relation Between Long Run Cost and Short Run Cost*
2. Chap 7: *Economies of Scale*
3. Chap 7: *Economies of Scope, Learning*

1 Relation Between Long Run Cost Short Short Run Cost

Since firms can change capital in the long run, the long run cost is always no more than the short run cost:

$$C_L R(q) \leqslant C_{SR,K}(q).$$

Figure 1 shows three short-run total cost given different capital level. In the long run, firms will choose the capital level which minimizes the total cost. Thus, the long-run total cost is equal to the minimum of all possible short-run total cost, and so long run total cost is the envelope of all short run total costs.
Likewise, long-run average cost is the envelope of all short run average cost. From Figure 1, we know for a given product q, long run marginal cost is equal to the corresponding short run marginal cost. Long run total cost and marginal cost also have the following relation: (see Figure 2)

- If
$$LMC < LAC,$$
LAC is decreasing;
- if
$$LMC = LAC,$$
LAC is minimized;
- if
$$LMC > LAC,$$
LAC is increasing.

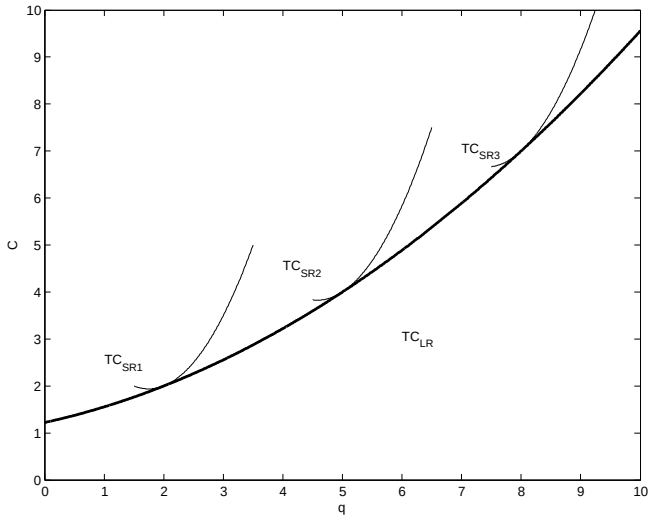

Figure 1: Deriving Long Run Total Cost from Short Run Total Cost.

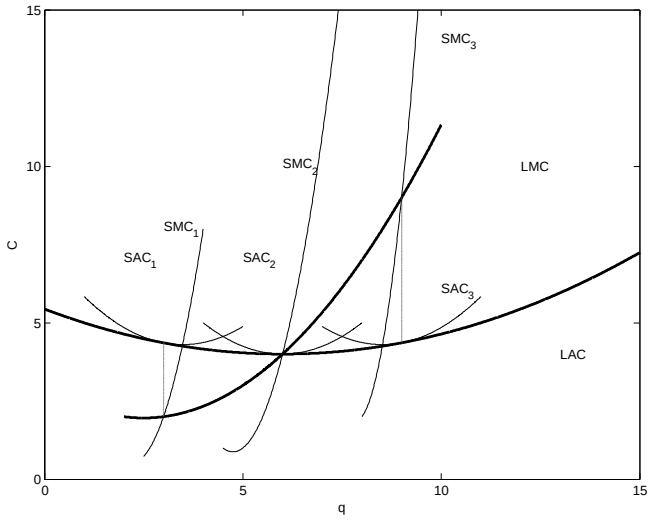

Figure 2: Deriving Long Run Average Cost and Marginal Cost from Short Run Average Cost and Marginal Cost.

2 Economies of Scale

- Constant economies of scale:

$$C(aq) = aC(q), a > 1,$$

and in this case, AC is constant;

- Economies of scale:

$$C(aq) < aC(q), a > 1,$$

and in this case, AC is decreasing;

- Diseconomies of scale:

$$C(aq) > aC(q), a > 1,$$

and in this case, AC is increasing.

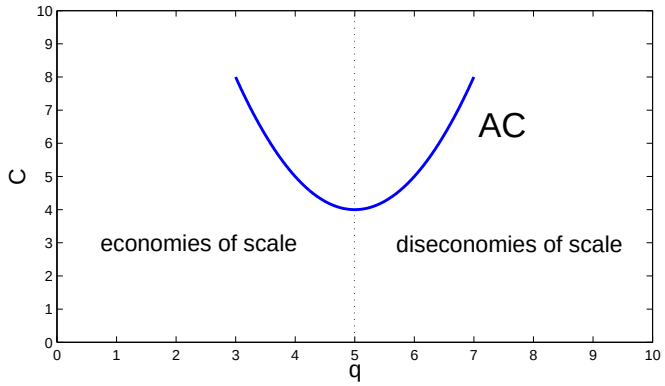

Figure 3: Production Dependence of Average Cost, Different Economies of Scale.

3 Economies of Scope, Learning

Economies of Scope. When producing more than one type of product that are closely linked, the cost is lower than when producing them separately.

Product Transformation Curve. Shows various combinations of outputs that can be produced with a given set of inputs.

Example (Product Transformation Curve with Economies of Scope). To produce 1 car and 1 truck, if we produce them separately, we need 2 units of K and 2 units of L; but if we produce them together, we only need 1.5 units of K and 1.5 units of L (see Figure 4). In this case, it is cheaper to produce them together; thus the firm has economies of scope.

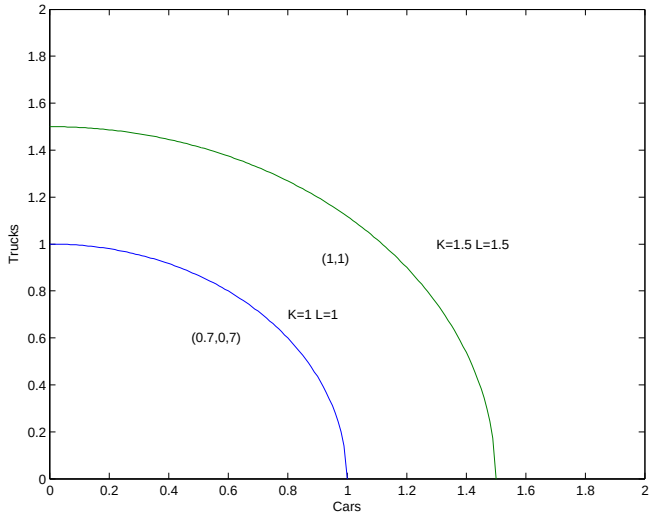

Figure 4: Product Transformation Curve with Economies of Scope.

In the case of economies of scope, the product transformation curve is negatively sloped and concave.

The degree of economies of scope is defined as follows:

$$SC = \frac{C(q_1) + C(q_2) - C(q_1, q_2)}{C(q_1, q_2)}.$$

- If
$$SC > 0,$$
it is economies of scope;
- if
$$SC < 0,$$
it is diseconomies of scope.

The learning curve for a firm is shown in Figure 5, with the firm's cumulative output as the vertical coordinate, and amount of inputs needed to produce a unit of output as the horizontal coordinate.

Learning causes a difference in cost between the new firm and the old firm (see Figure 6).

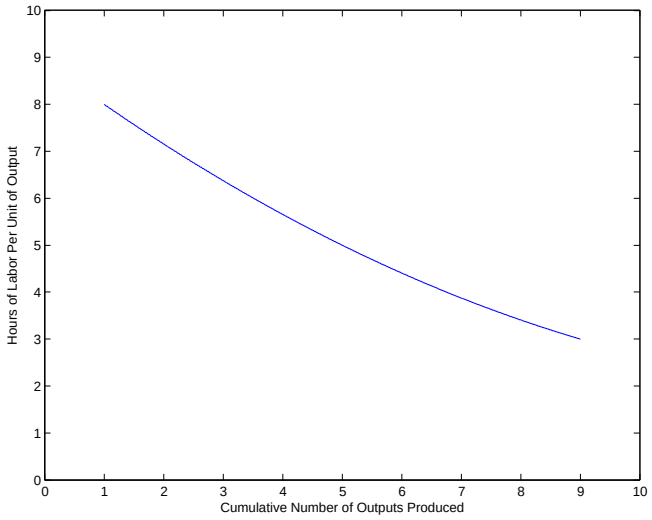

Figure 5: Learning Curve of a Firm.

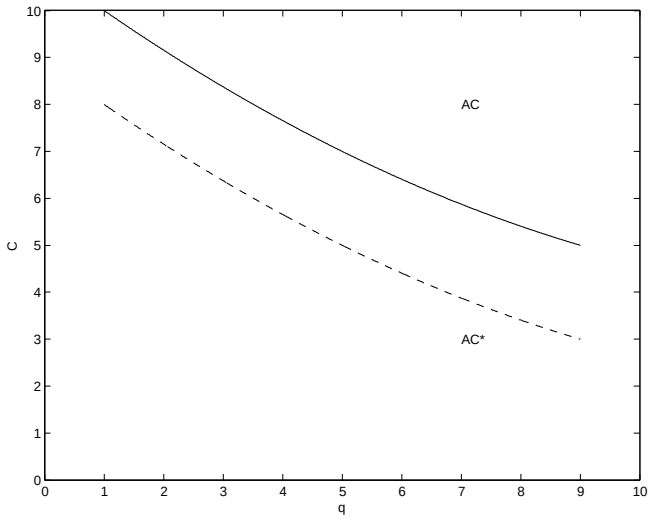

Figure 6: Shift of Cost Curve from Learning.

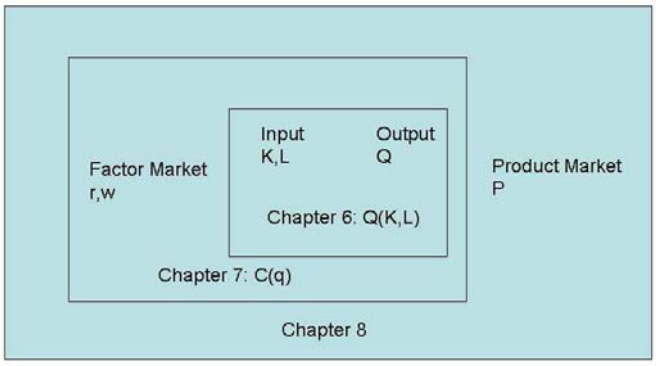

Figure 7: Structure of Production Theory.