Synopsis of the fourth lecture in ECO 5315
(The Analysis of Costs and Perfect Competition)

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October 27, 2009

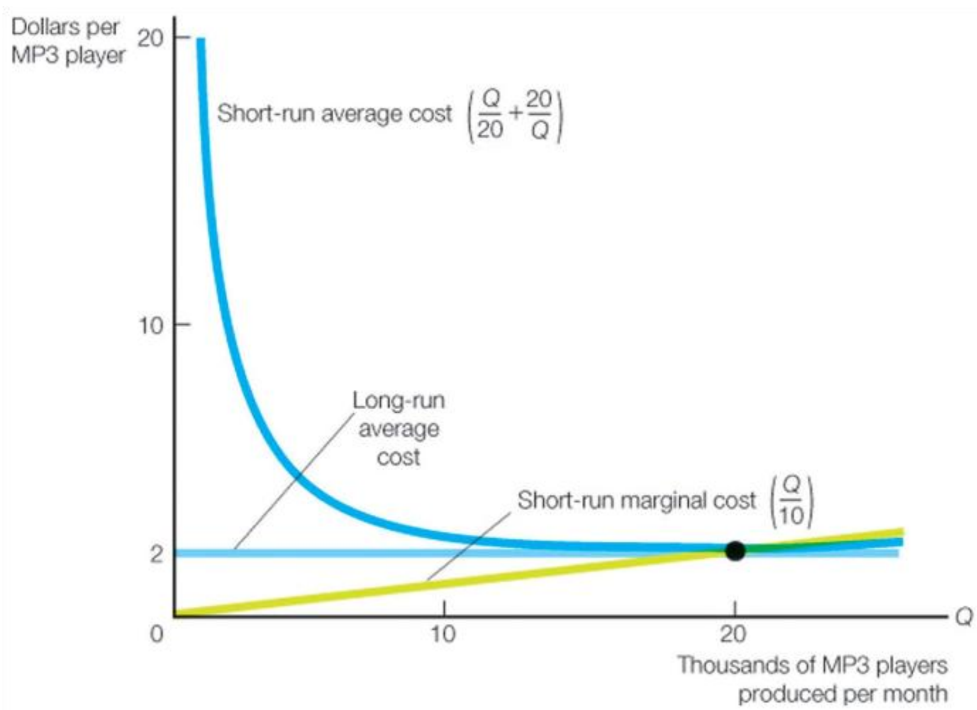
Chapter 5 (The Analysis of Costs)

Chapter 5 addresses the question of how to determine optimal firm size, given the firm's production function and the costs of inputs such as labor and capital. This information allows us to determine short-run and long-run cost functions. In the short-run, variable inputs are allowed to change, but fixed inputs are held constant. The logic behind this analysis is that in the short-run, there are likely to be significant adjustment costs (involving both time and money) associated with changing long-run inputs (e.g., land and buildings). Therefore, it makes sense to treat long-run inputs as fixed in the short-run. However, in the long-run everything becomes variable.

For example, think about how short-run and long-run responses to changes in enrollment might look like at a university. Suppose the demand for university education goes up from one academic year to the next. Then an appropriate short-run response might involve hiring additional lecturers and administrative staff, purchasing additional supplies, etc. These are all "variable" inputs that are easily scaled to the required levels (up or down). However, if this growth continues, then at some point (i.e., in the "long-run"), new facilities may become necessary in order to accommodate further growth. Since new facilities are not immediately necessary in the "short-run", it's okay (actually, it's a particularly *good* idea) to focus your attention upon making appropriate adjustments in the short-run variable inputs.

We developed the concept of the long-run average cost (*LRAC*) curve, and showed that the optimal firm size occurs when we minimize long-run average cost. This occurs when The primary factor determining the shape of the *LRAC* curve is returns to scale. Empirically, most long-run cost curves are *u-shaped*; they initially exhibit increasing returns to scale (which is why they initially have negative slopes), then constant (this occurs over the region of the *LRAC* curve where the slope is flat), and finally decreasing returns to scale (which occurs over a region of the *LRAC* curve where the slope is positive). While long-run average cost curves share a similar shape with short-run average curves, the *source* of the shape is different. With short-run cost curves, the u-shape is caused by *diminishing returns of inputs*, with long-term curves it is the increasing, constant, and decreasing returns to scale.

In the “Problem Solved: Managerial Use of Cost Functions” box on pp. 142-143 (see pp. 12-14 of Lecture 5), we showed how to determine optimal firm size in the case of a firm with constant returns to scale. The production function was given as $Q = 4K^{0.5}L^{0.5}$. (We know that this production function implies constant returns to scale because the output elasticities of capital (*K*) and labor (*L*) are indicated by these variables’ exponent values, and the exponents sum to 1). Furthermore, labor is paid $8 per hour in this numerical example, whereas capital costs $2 per unit. We showed that by minimizing the firm’s long-run average cost, that optimal firm size required scaling this company so that it is capable of producing 20,000 units of output per month. This result is indicated by the graph given below:



We concluded our discussion of Chapter 5 by discussing the concept of *economies of scope*. Economies of scope exist when the cost of producing two (or more) products jointly is less than the cost of producing each one alone. For example, consider the case of a firm which can produce either 1 or 2 products. Let $C(Q_1)$ represent the cost of producing only product 1, $C(Q_2)$ represent the cost of producing only product 2, and $C(Q_1+Q_2)$ represent the cost of jointly producing products 1 *and* 2. Then the firm will opt for joint production if there are economies of scope. There are economies of scope if $C(Q_1+Q_2) < C(Q_1)+C(Q_2)$, or if $S = \frac{C(Q_1)+C(Q_2)-C(Q_1+Q_2)}{C(Q_1+Q_2)} > 0$. In this equation, *S* represents a simple *synergy* measure. The numerator represents the net cost benefit of joint production, as a proportion of the cost of joint production.

Chapter 6 (Perfect Competition)

Chapter 6 represents the first of three chapters which address the topics of market structures and pricing strategies (the other two chapters are chapter 7 (Monopoly and Monopolistic Competition) and 10 (Oligopoly). Perfectly competitive markets are characterized by market structures in which many firms produce identical products with no control whatsoever over price.[1] In such markets, non-price competition (e.g., advertising) is unnecessary since identical products cannot be meaningfully differentiated. Furthermore, no barriers to entry or exit exist, which pretty much means that firms are free to come and go as they please. Because of these characteristics, no one firm has any market power; consequently, firms in a perfectly competitive market cannot affect prices by changing their production decisions. Rather, they act as "price takers"; i.e., they take prices as "given", and there is no economic profit. What we mean by zero economic profit is that firms are able to cover the opportunity costs of capital, but no more. In other words, it is not possible to earn "excess" profits over and above the opportunity cost of capital.

The opposite end of the market structure continuum from perfect competition is monopoly. In the case of monopoly, rather than have large numbers of firms acting as price takers, we have only one firm acting as a "price maker". [2, 3] The monopolist is a price maker in the sense that its production decision directly affects market prices. Monopolistic markets are characterized by substantial barriers to entry and exit, and there can be substantial economic profit. A particularly interesting "intermediate" case involves oligopoly, which is a market structure characterized by a limited number of firms and high entry barriers.[4]

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[1] Typical examples of perfectly competitive markets include agricultural markets, commodity markets, financial markets, eBay auctions, markets for open source software, etc.

[2] "Natural" monopolies may occur in situations where the *LRAC* is always declining; i.e., there are no diseconomies of scale. Public utility firms are typically cited as examples of natural monopoly. From a social standpoint, a reasonably logical and coherent argument can be made for allowing such firms to exist so as to take advantage of scale economies, and then to regulate the prices that they can charge so that the economic benefits of these scale economies (also known as "producer surplus") accrues to consumers rather than investors.

[3] More recently (during the past 15 years or so), Microsoft has had repeated confrontations with the US Federal Trade Commission, the US Department of Justice, and European Community-equivalent regulatory organizations involving anti-trust regulatory actions. In these actions, Microsoft is characterized as a monopolistic firm, although it might be more accurate to characterize Microsoft as an *oligopolistic* firm, since the markets in which it competes are (at least in principle) contestable; e.g., in the operating system space, you have Mac OS, various flavors of Unix, Linux, etc., and in the office suite space, you have open-source software (e.g., Star-office and Google Office software).

[4] Obvious" examples of oligopoly include the automobile, airline, pharmaceutical, and overnight (express) delivery industries (e.g., UPS and FEDEX).

Perfectly competitive markets are not strategically interesting because managers cannot affect behavior in them. However, they lay the groundwork for our examination of more strategically interesting markets where managers must consider (and anticipate) the actions of other market players (e.g., consumers, rivals) in setting prices. Thus monopolistic competition and oligopoly provides us with a natural segue into the game theory (Chapter 11).

Since firms which compete in perfectly competitive markets take prices as given, they face a perfectly elastic demand curve. This brings us back to an important price theory result from Chapter 2. Recall equation 2.15 on page 47 of the textbook:

$$MR = dTR/dQ = d(PQ)/dQ = P\frac{dQ}{dQ} + Q\frac{dP}{dQ} = P\left[1 + \frac{Q}{P}\frac{dP}{dQ}\right] = P\left(1 + \frac{1}{\eta}\right).$$

Since the profit maximizing condition is that $MR = MC$, this implies that

$$MC = dTC/dQ = P\left(1 + \frac{1}{\eta}\right)$$

for a profit maximizing firm. Since η for a perfectly elastic demand curve is $-\infty$, this implies that $MR = MC = P$ for a perfectly competitive firm.

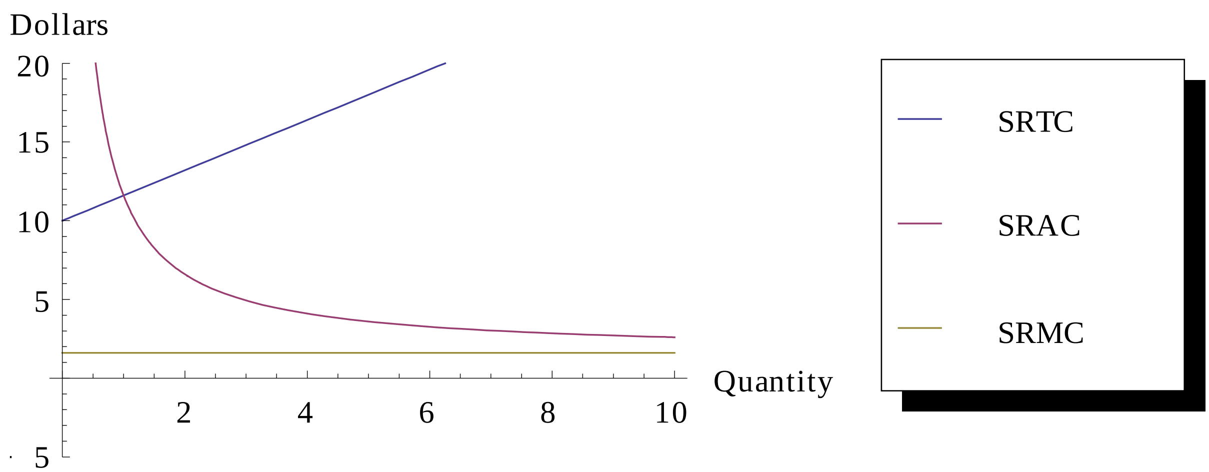
The dynamics of a perfectly competitive market as follows:

- In the short run, output will occur where $MR = MC$, and revenue is greater than variable cost.
    - Above-normal short-run profits are possible; e.g., one firm may have lower costs than its rivals.
    - However, if markets are competitively structured, then long-run economic profits get quickly dissipated.
    - Suppose such profits exist; then new firms will enter the market (since there are no entry barriers), output will increase, and price will fall until zero economic profits are earned.

Appendix (Optional): Economies of scale when there are increasing returns to scale

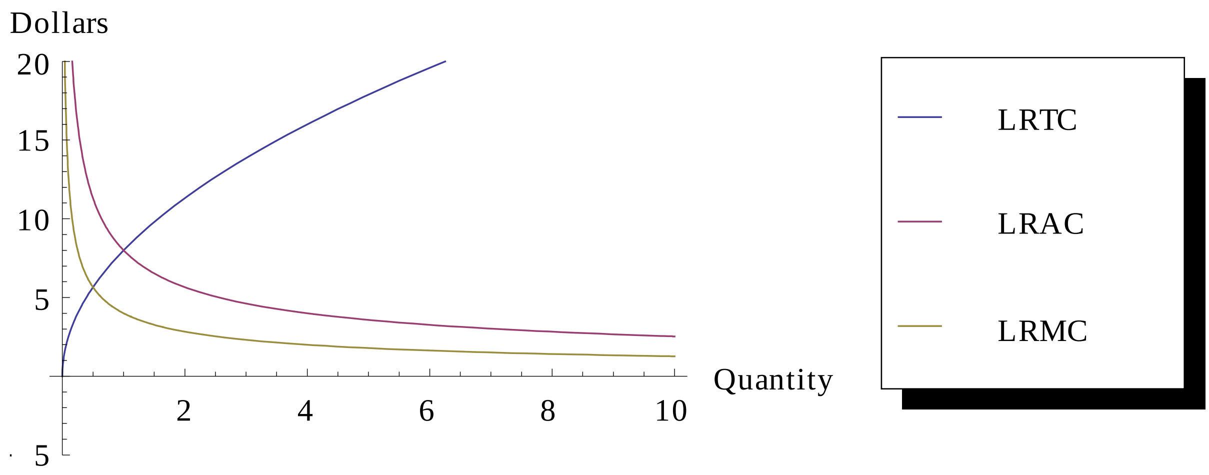
In this appendix, I rework the "Problem Solved: Managerial Use of Cost Functions" box on pp. 142-143 for the case of a production function that has increasing returns to scale. Suppose that the firm's production function $Q = KL$, labor costs $8 per and capital costs $2 per unit. Thus $L = Q/K$, and total costs are $TC = 8L + 2K = 8\frac{Q}{K} + 2K.$

Next, we derive short-run and long-run cost functions. In the short-run, suppose that K = 5 units. Thus, $TC_S = 1.6Q + 10$, $AC_S = TC_S / Q = 1.6 + 10 / Q$, and $MC_S = dTC_S / dQ = 1.6.$ Here's how these short-run cost functions look graphically:



In the long run, K can vary. Thus, $TC_L = 8Q / K + 2K$. Since we are only interested in considering combinations of K that will enable us to minimize total cost, we differentiate TC_L with respect to K, set this derivative equal to 0, and solve for K. Thus, $dTC_L / dK = -8Q / K^2 + 2 = 0 \Rightarrow K = 2\sqrt{Q}$. Substituting this result back into the equation for TC_L, we obtain $TC_L = 8Q / 2\sqrt{Q} + 2(2\sqrt{Q}) = 8\sqrt{Q}$. Thus, $AC_L = TC_L / Q = 8 / \sqrt{Q}$, and $MC_L = dTC_L / dQ = 4 / \sqrt{Q}$.

Here's how these long-run cost functions look graphically:



The bottom line is that when there are increasing returns to scale, both the short-run and long-run average cost curves are decreasing in the quantity produced; i.e., there are scale economies. Note that the long-run marginal cost curve in the graph above never intersects the long-run average cost curve, so it is not possible in this case to minimize long-run average cost, irrespective of how the firm is scaled. In fact, if the firm enjoys increasing returns to scale for all possible capital and labor combinations, then such a firm is a *natural monopoly*.