Some basics in the theory of the firm

1. The firm’s simple cost structure

Definitions:
Marginal cost (MC): The firm’s marginal cost is a concept that pertains to (infinitesimally small) changes in the amount a firm produces at varying levels of total output. Specifically, MC measures by how much a firm’s costs will increase [decrease] if the firm increases [decreases] its current output by one more [fewer] (infinitesimally small) unit(s).

Average cost (AC): The firm’s average cost is a cost concept that pertains to the total level of output of the firm. It measures how much—on average—a unit of output costs the firm given its current level of production. As such, it is often also referred to as the unit cost of production (given the level of output that the firm produces).

As indicated by the definitions, both types of costs may vary with the amount that the firm produces. The graph below depicts the two types of costs as functions of varying levels of the firm’s total output, which is denoted by $q$.

The U-shape of the two curves is somewhat typical in that it is frequently the case that at small levels of the firm’s output an increase in output allows the firm to combine its inputs in a more efficient manner so that marginal and average costs decline initially. However, it is also typical that as the scale of operations (the firm’s output) increases to larger and larger levels, it may become more difficult to organize production so that initially marginal and subsequently average costs increase.

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1 Beware: all references to costs refer to economic costs, not accounting costs.
Notice that marginal costs are exactly equal to average costs at the output at which the firm's average costs are at a minimum. At smaller levels of output the marginal cost is below the average cost and the average cost is decreasing; at larger levels of output the marginal cost is above the average cost and average cost is increasing. Recalling the definitions of marginal and average cost, this relationship is no coincidence. That is, whenever the cost of producing one more unit of output is smaller than the unit costs are, producing more units will decrease unit costs (so AC is decreasing whenever MC < AC). By the same token, whenever producing additional units costs more than unit costs are at that point, an increase in output will increase the average cost of output (so that AC is increasing whenever MC > AC). Consequently, it must be the case that at the level of output at which the average cost goes from decreasing to becoming increasing, the marginal cost must go from being below average cost to becoming greater than average costs. In other words, marginal cost intersects (and is therefore equal to) average cost at the minimum of average cost.

2. Firm behavior

We generally assume the decisions in a firm are geared towards maximizing the present value of the firm. For simplicity, we will focus on static profit maximization. To this end recall that the firm's (economic) profit is given by the difference between the revenue that the firm takes in and its (economic) costs of operations. Revenue is of course the total output of the firm multiplied by the price it obtains per unit, i.e., the value of sales volume. In order to determine the firm's optimal (i.e., profit-maximizing) strategy the notion of marginal revenue is instrumental.

**Definition:** *Marginal revenue* (MR): At any level of firm sales, marginal revenue measures by how much a firm's revenues will increase [decrease] if the firm sells one more [less] (infinitesimally small) unit.

The notions of marginal cost and marginal revenue together can be used to determine the firm's profit maximizing level of output. Logic dictates that the firm must be operating at a level at which either (a) marginal cost is less than marginal revenue, (b) marginal cost is greater than marginal revenue, or (c) marginal costs is exactly equal to marginal revenue. Consider the three scenarios in turn.

**MC < MR.** The cost of producing another unit is smaller than the increase in revenue when selling another unit. Consequently, whatever the amount of profit that is that the firm is currently making, if it produces another unit and sells this unit, profit must increase as the increase in revenue exceeds the increase in costs. Therefore the firm should expand its output.

**MC > MR.** Now expanding output will increase costs more than the firm benefits from the resulting increase in revenue. Put another way, the savings that the firm experiences by producing one less unit (MC) are greater than the loss in revenue when selling one fewer units (MR). Consequently, the firm increases its profits by reducing its output.

**MC = MR.** In light of the above arguments it is clear that the firm will maximize profit only if MR = MR.
3. Output decision of a firm with pricing power (e.g. a monopoly)

When we speak of a firm with pricing power, we think of the firm having to make two decisions. One is How much to produce, and the other is Which price to charge. However, it turns out that given the demand for the firm’s product, the two questions reduce to one and the same, namely Having determined the optimal price, produce whatever is demanded at that price, or Having determined the optimal output, charge the highest price that people are willing pay in order to sell that amount of output. Indeed, the question of optimal price and output are answered simultaneously—the firm need only determine the profit maximizing point (price/output combination) on the demand curve for its product. In order to do so, consider the diagram below. Depicted is the cost structure of the firm, the demand curve for the firm’s product, and the marginal revenue curve that is associated with this demand curve.

How is marginal revenue related to demand? Notice that at the intercept the two functions are the same. This is because at this point the change in revenue when going from not selling any output to selling the first unit of output is simply equal to the price at which the initial unit is sold. That is, marginal revenue is equal to the price, which is given by the demand curve. Notice, however, that elsewhere the marginal revenue curve is below the demand curve. The reason for this is that as the firm wants to sell more units, it must charge a lower price (the demand curve slopes down). In fact, it lowers its price on all units sold, so that it will make less money on the second unit sold, as well as on the initial unit sold. Thus revenue obtained from both the initial and the second units are affected so that marginal revenue is smaller than the new price. Because the number of units for which the price reduction takes hold increases as output expands, the discrepancy between demand (i.e., price) and marginal revenue becomes larger with increases in output.

As indicated above the firm’s output decision is determined where marginal cost is equal to marginal revenue, so the firm produces the amount \( q^m \). The price associated with this output is the highest price the firm can charge and still sell \( q^m \). That is, as indicated at the outset, the price on the demand curve, given by \( p^m \).
4. Output decision of a perfectly competitive firm (a price-taking firm)

A firm in perfect competition cannot affect the price for its product. Instead, the price is determined by the equilibrium in the market for the good, and the firm takes the equilibrium price as given. Thus, whenever the firm sells one more unit of the good, its revenue will increase by exactly the amount of the market price. Conversely, if the firm sells one fewer units, its revenue will decrease by the market price. Consequently, recalling the definition of marginal revenue, the marginal revenue is given by the market price.

The diagram below depicts both a firm and the corresponding market. Given the equilibrium in the market, the panel on the left depicts the firm’s profit maximizing output decision—the point at which marginal cost is equal to the marginal revenue.