Microeconomics with Ethics

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Chapter 12
Perfectly Competitive Markets: Part 1

This chapter introduces the market structure that economists call perfect competition (PC). *Perfect competition* refers to a collection of assumptions that includes, a) there are many, many, firms producing a homogeneous, or perfectly substitutable, product, b) each firm is so small, relative to the size of the market, that its actions cannot affect the market price, and c) each firm therefore behaves as a price-taker, meaning it assumes the market price is exogenous and chooses its output so as to maximize its own profit at that given price. Perfect competition also means that there is so much competition that market power, meaning the ability to influence the product price via strategic behavior, is completely eliminated.

Some other assumptions of perfect competition are carried over from earlier models. Namely, that there are many consumers of the product, such that each consumer is too small to be able to bargain for a better price. In other words, consumers do not have monopsony power. PC also assumes that all market participants have perfect information. In the case of firms, this means that all firms have the same knowledge about production technologies and will all choose the most effective (and identical) production technique. This implies that every firm has the same cost curves as described in Chapter 9. Perfect information also means that all market participants know when firms in an industry are earning positive profit and when they are losing money. This knowledge will influence entrepreneur's decisions to enter or exit an industry and this will affect the number of firms producing. Perfect information for consumers means they all know their own preferences and perfectly know the quality and prices of all available goods and services in the market.

Reality Check

Although the conditions of perfect competition are rarely, if ever, satisfied in the real world, this market assumption is extremely useful as a reference. We will see later that economic efficiency is best realized under the assumptions of perfect competition and even though this can never be realistically realized, the model describes what it would take to achieve this kind of perfection. The economist Harold Demsetz once fittingly described a perfectly competitive market as *economic nirvana*, suggesting that while we might wish to strive for this outcome, it is almost impossible to achieve.

Later in the text we will introduce the concept known as market imperfections. *Market imperfections* represent situations in which one or more of the assumptions of perfect competition are not satisfied. Not only will these models illustrate the importance of each relaxed assumption, they will also describe markets that are closer to real world markets.

12.1 Production Decision of a Representative Firm

Learning Objectives

1. Learn the characteristics of perfect competition.
2. Learn the condition a profit-maximizing firm will use to determine output under the assumptions of perfect competition.
3. Learn to depict graphically the positive-profit, negative-profit, and zero-profit outcomes for a perfectly competitive firm.

To analyze production decisions in a perfectly competitive market, we look at one small firm. It is called a representative firm because by virtue of the assumption that all firms have perfect information, it means that all firms are identical to each other in terms of their cost functions. Thus, the behavior of one firm represents the conditions and behavior of every firm in the market.

We will assume the representative firm has standard cost functions as described in Chapter 9. This means that production has both fixed and variable costs and exhibits increasing returns to scale at low levels of production followed by decreasing returns to scale at higher levels of production. This generates a typical U-shaped average cost curve with a U-shaped marginal cost intersecting AC at its minimum value. In order to satisfy the assumption that each firm is too small to noticeably affect the market price, each firm's minimum average cost must be very small relative to the total size of the market. Note: this assumption would not be satisfied for a product that has the characteristics of a natural monopoly.

Production with Positive Profit

To simplify the model presentation, we will use the same Bewitched Broom factory values from Chapter 9. In the first example, presented in Table 12.1, we assume the market price is $10 per broom. The price is said to be exogenous, meaning that its value is determined external to the firm and the firm takes the price as an input into its decision making. This is why perfectly competitive firms are often described as price-takers. The ultimate source of the market price will be discussed later after the market supply curve is derived. The only decision the representative firm can make is how much to produce, not what price to charge.

Total revenue for the firm is listed in column 2 in Table 12.1. It is calculated simply by multiplying the $10 market price by the output levels in Column 1. Marginal revenue is reported in Column 3. Note that with a fixed price, marginal revenue is equal to the fixed price of $10. Also, note that in perfect competition, the marginal revenue curve would be drawn as a horizontal line at the market price of $10 rather than a downward sloping line as shown in the monopoly market case in Chapter 10. Total cost under the model assumptions of a $200 fixed cost and a variable cost of $100 per worker yields the total cost schedule in column 4. Marginal cost is the same as was calculated previously in Chapter 9. Finally, profit is shown in column 6, calculated as the difference between Total Revenue and Total Cost.

We assume that the representative firm's behavioral objective is to maximize its profit. It does so by following the same rule as the monopolist, namely choose the output quantity that equalizes marginal revenue with marginal cost. However, under the assumptions of perfect

competition, marginal revenue is always equal to the market price. Thus, the profit maximizing condition for a perfectly competitive firm simplifies to

$$P = MC$$

In other words, a firm should choose that output such that the product price is equal to the marginal cost.

Notice that we are using a small q to denote quantity to indicate that this is just one firm's output rather than the market output. We will use a capital Q later to refer to total market output.

In Table 12.1, although price is constant for all levels of output, marginal cost equals $10 only at the output level 150 brooms. Profit is also highest at $700. Although there is another output (q=140) that will also generate $700 in profit it is best to choose the level where P = MC. Simply recognize, as we did in the previous chapters, that there will be problems finding unique solutions due to the discrete output steps in the Table. If we specified the cost functions with continuous functions instead, then we could use calculus to determine a truly unique solution.

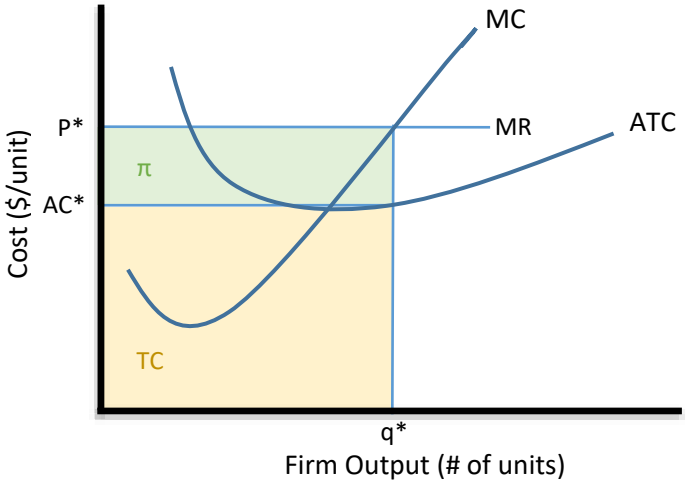
Table 12.1 The Bewitched Broom Production Costs

Firm Output (q) (#)	**Total Revenue** TR = P*q ($)	**Marginal Revenue** MR = ΔTR/Δq ($/broom)	**Total Cost** TC=FC+VC ($)	**Marginal Cost** MC = ΔTC/Δq ($/broom)	**Profit** Π =TR - TC ($)
0	0		$200	---	- $200
20	$200	$10	300	$5.00	- 100
50	$500	10	400	3.33	+ 100
90	$900	10	500	2.50	+ 400
120	$1200	10	600	3.33	+ 600
140	$1400	10	700	5.00	+ 700
150	$1500	10	800	10.00	+ 700
155	$1550	10	900	20.00	+ 650

Figure 12.1 provides a graphical depiction of the representative firm's decision and outcome in perfect competition (PC). Note that the marginal cost and average cost curves are drawn with the shapes indicated in Table 12.1 but are generalized because the graph does not display the actual values. The price of $10 from the Table is generalized to P* in the graph. The horizontal line at P* is also the marginal revenue curve (or line) for the price-taking firm.

Notice that P* = MC at the quantity q*. Thus, q* is the profit maximizing output choice for the firm. Total revenue to the firm is given by the product P*q* and is represented by the colored area in the graph (both yellow and green areas combined). Total cost is found by first determining the average cost AC at the output level q*. Simply find where the vertical line at q* intersects the AC curve and determine AC* (= AC(q*)) along the vertical axis. This implies that total cost TC = AC*q* which is represented by the yellow area on the graph. Finally, firm profit, measured by the difference between total revenue and total cost, is represented by the green area on the graph.

Figure 12.1 A Representative PC Firm with Positive Profit



Production with Negative Profit

In the second example, presented in Table 12.2, we assume the market price is $3.33 per broom. Remember that the firm has no control over the market price; it might be high or low depending on other external conditions. In this example, we consider the outcome when the price is relatively low.

Revenues, costs and profits for the firm are recalculated with the $3.33 price and are listed in Table 12.2. Notice that marginal revenue is now fixed at the price of $3.33 and is equal to marginal cost at two output values, q=50 and q= 120. Examining the profit column we can see that profit begins at - $200 when output is zero (this is the fixed cost in production), falls to - $233.33 at output levels 20 and 50 brooms, and then rises to - $200 at output levels 90 and 120 brooms. At higher levels of output, profit continually falls even further. Clearly the highest profit attainable is - $200, which is the point where the second intersection of price and marginal cost occurs. This is indeed the profit maximum for the firm. In actuality the true maximum will occur between 90 and 120 brooms at a value like 105 brooms but, because we do not show all values in the Table, the solution shown is only an approximation. In general, when faced with a situation where P = MC at two output levels, the true profit maximum is the equality where the marginal cost is rising, not falling, with increases in output. The first equality is actually determining a local profit minimum, rather than a maximum value for profit.

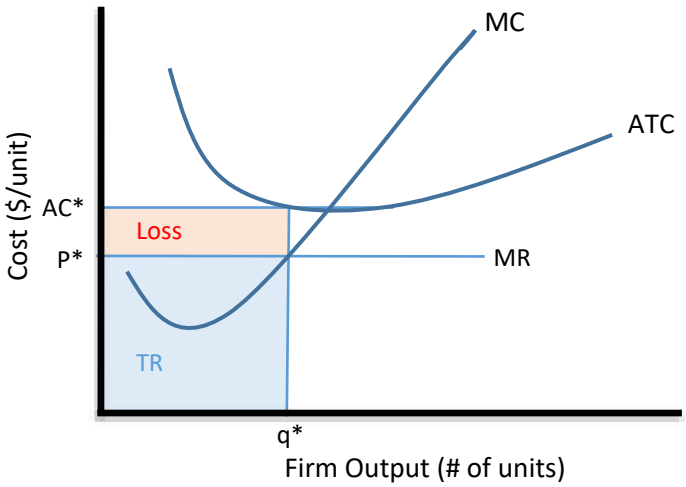
Table 12.2 The Bewitched Broom Production Costs

Firm Output (q) (#)	**Total Revenue** TR = P*Q ($)	**Marginal Revenue** MR = ΔTR/ΔQ ($/broom)	**Total Cost** TC=FC+VC ($)	**Marginal Cost** MC=ΔTC/ΔQ ($/broom)	**Profit** Π =TR - TC ($)
0	0		$200	---	- $200
20	$66.7	$3.33	300	$5.00	- 233.33
50	$166.67	3.33	400	3.33	-233.33
90	$300	3.33	500	2.50	-200
120	$400	3.33	600	3.33	-200
140	$466.67	3.33	700	5.00	-233.33
150	$500	3.33	800	10.00	-300
155	$516.67	3.33	900	20.00	-383.33

Figure 12.2 provides a graphical depiction of the representative firm's decision and outcome in perfect competition (PC). Again the marginal cost and average cost curves are drawn with the shapes indicated in Table 12.1 but are generalized because the graph does not display the actual values. The price of $3.33 from the Table is generalized to P* in the graph. The horizontal line at P* is also the marginal revenue curve (or line) for the price-taking firm.

Again, P* = MC at the quantity q* where MC is rising with increases in output. Thus, q* is the profit maximizing output choice for the firm. Total revenue to the firm is given by the product P*q* and is represented by the blue-colored area in the graph. Total cost is found by first determining the average cost AC at the output level q*. Again find where the vertical line at q* intersects the AC curve and measure AC* (= AC(q*)) along the vertical axis. This implies that total cost TC = AC*q* which is represented by the entire colored area on the graph (both red and blue areas combined). Finally, firm profit, or loss in this case, is measured as the difference between total revenue and total cost and is represented by the red area on the graph, which has negative value because total costs exceed total revenue.

Figure 12.2 A Representative PC Firm with Negative Profit



Production with Zero Profit

In the third example, presented in Table 12.3, we assume the market price is $5 per broom. Revenues, costs and profits for the firm are recalculated with the $5 price and are listed in Table 12.3. Notice that marginal cost equals $5 only at the output level 140 brooms. Profit is also at its highest value under the circumstances at $0. Although there is another output (q=120) that will also generate $0 in profit it is best to choose the level where P = MC. This is indeed the profit maximum for the firm. In actuality, the true maximum may occur between 120 and 140 brooms at a value like 130 brooms but, because we do not show all values in the Table, the solution shown is only approximate.

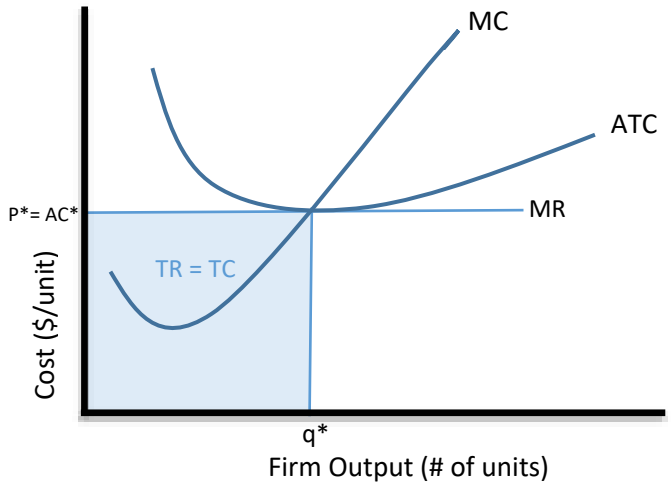
Table 12.3 The Bewitched Broom Production Costs

Firm Output (q) (#)	**Total Revenue** TR = P*Q ($)	**Marginal Revenue** MR = ΔTR/ΔQ ($/broom)	**Total Cost** TC=FC+VC ($)	**Marginal Cost** MC=ΔTC/ΔQ ($/broom)	**Profit** Π =TR - TC ($)
0	0		$200	---	- $200
20	$100	$5	300	$5.00	- 200
50	$250	5	400	3.33	-150
90	$450	5	500	2.50	-50
120	$600	5	600	3.33	0
140	$700	5	700	5.00	0
150	$750	5	800	10.00	-50
155	$775	5	900	20.00	-125

Figure 12.3 provides a graphical depiction of the representative firm's decision in this third case. The price of $5 from the Table is generalized to P* in the graph. The horizontal line at P* is also the marginal revenue curve (or line) for the price-taking firm.

Again, P* = MC at the quantity q*. Thus, q* is the profit maximizing output choice for the firm. Total revenue to the firm is given by the product P*q* and is represented by the blue-colored area in the graph. Total cost is found by first determining the average cost AC at the output level q*. In this case, AC* is equal to the price P*. This implies that total cost, TC = AC*q*, is also represented by the blue-colored area on the graph. Finally, firm profit is measured by the difference between total revenue and total cost and is zero here (no area to show) because these two values are the same.

Figure 12.3 A Representative PC Firm with Zero Profit



Of the three cases presented above, which one arises will depend on the market conditions which determine the market price, for which the representative firm is assumed to have no control over. However, if the conditions are such that the representative firm makes positive profit, then all firms in the industry will also be making positive profit. The same is true for the other scenarios. The implications of these different outcomes will be addressed in subsequent chapters.

Key Takeaways

1. *Perfect competition* refers to a collection of assumptions that includes,
    a. there are many, many, firms producing a homogeneous, or perfectly substitutable, product,
    b. each firm is so small, relative to the size of the market, that its actions cannot affect the market price, and
    c. each firm therefore behaves as a price taker, meaning it assumes the market price is exogenous and chooses its output so as to maximize its own profit at that given price.
2. Perfect competition also assumes the market has numerous consumers, none of whom have monopsony power, and perfect information available to both consumers and producers so that optimal decisions can be made.
3. The profit-maximizing rule for a representative PC firm is to choose output such that the market price of its product is equal to marginal cost at that output level. Namely choose output such that P = MC.
4. Figures 12.1, 12.2, and 12.3 show how to depict total revenues, total cost and profit for a representative PC firm in the three possible outcomes, namely, positive-profit, negative-profit and zero-profit.