Chapter 10

Perfect Competition
Chapter Outline

• Goal of Profit Maximization
• Four Conditions for Perfect Competition
• Short-run Condition For Profit Maximization
• Short-run Competitive Industry Supply, Competitive Equilibrium and Efficiency
• Producer Surplus
• The Invisible Hand
• Long-run Competitive Industry Supply Curve
• Elasticity of Supply
The Goal of Profit Maximization

- **Economic profit**: the difference between total revenue and total cost, where total cost includes all costs—both explicit and implicit—associated with resources used by the firm.

- **Accounting profit** is simply total revenue less all explicit costs incurred.
  - does not subtract the implicit costs.

- Economists assume that the goal of firms is to maximize economic profit.
The Four Conditions For Perfect Competition

1. **Firms Sell a Standardized Product**
   - The product sold by one firm is assumed to be a perfect substitute for the product sold by any other.

2. **Firms Are Price Takers**
   - This means that the individual firm treats the market price of the product as given.

3. **Free Entry and Exit**
   - With Perfectly Mobile Factors of Production in the Long Run

4. **Firms and Consumers Have Perfect Information**
Short-Run Condition For Profit Maximization

• To maximize profit the firm will choose that level of output for which the difference between total revenue and total cost is largest.

• *Marginal revenue:* the change in total revenue that occurs as a result of a 1-unit change in sales.

• *To maximize profits the firm should produce a level of output for which marginal revenue is equal to marginal cost on the rising portion of the MC curve.*
Total Revenue, Total Cost, and Economic Profit

• For Figure 10.2, suppose a perfectly competitive firm can sell as many units as it likes for \( P = $18 \).

• Total revenues are \( TR = PQ = 18Q \). Every unit sold adds $18 to total revenue.

• Total revenue versus quantity is a straight line with slope \( P = 18 \) and intercept 0 (zero revenue if sell nothing).
Total Revenue, Total Cost, and Economic Profit

• Economic profit is total revenue minus total cost \( TR - TC \).
• For Figure 10.2, profit begins at \( -FC = -30 \) when sell nothing \( (Q = 0) \). Cannot avoid fixed costs even if produce nothing. Variable costs zero.
• From zero to \( Q = 4.7 \) and again \( Q = 8.7 \) and above, profits are negative as \( TC > TR \).
• From \( Q = 4.7 \) to \( 8.7 \), profits positive as \( TR > TC \).
• Profits maximized at \( Q = 7.4 \) where the amount that \( TR \) exceeds \( TC \) is the greatest.
Figure 10.2: Total Revenue, Total Cost, and Economic Profit

Total revenue and total cost ($/wk)

Profit ($/wk)

\( \Pi = TR - TC \)

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Profit-Maximizing Output Level in the Short Run

- Figure 10.3 represents this same situation but looking at marginal cost, marginal revenue, and average variable cost.
- Marginal revenue is constant at \( P = MR = $18 \) so a horizontal line with respect to quantity.
- Marginal cost will typically decline over some range then increase.
- Profit-maximizing quantity occurs where \( P = MR = MC \) (along rising portion of marginal cost), provided that \( P > \min(\text{AVC}) \).
  - If price fails to cover AVC, the firm should shut down (produce nothing \( Q = 0 \)).
Profit-Maximizing Output Level in the Short Run

• Quantity $Q = 7.4$ maximizes profits.
• For all units up to $Q = 7.4$ along the rising portion of $MC$, $18 = P = MR > MC$ so each unit contributes positively to profits on the margin.
  – If selling less than 7.4, firm should expand.
• For all units beyond $Q = 7.4$, $MC > MR$ so these units would have a negative impact on profits if sold.
  – If selling more than 7.4, firm should contract.
Figure 10.3: Profit-Maximizing Output Level in the Short Run
The Shutdown Condition

• **Shutdown condition:** if price falls below the minimum of average variable cost, the firm should shut down in the short run.

• The *short-run supply curve* of the perfectly competitive firm is the rising portion of the short-run marginal cost curve that lies above the minimum value of the average variable cost curve.
  – Upward sloping
Figure 10.4: The Short-Run Supply Curve of a Perfectly Competitive Firm
Short-Run Competitive Industry Supply Curve

• Add up the output of each firm in an industry to get the industry supply curve.

• For Figure 10.5, one firm produces nothing until the price reaches \( P = 2 \), when produces \( Q_1 = P \). Another firm produces nothing until \( P = 3 \), when produces \( Q_2 = 1 + P \).

• Industry output \( Q = Q_1 + Q_2 \) is 0 until \( P = 2 \), \( Q = P \) from \( P = 2 \) to 3, then \( Q = 1 + 2P \) for \( P = 3 \) and above.
Figure 10.5: Short-Run Competitive Industry Supply Curve
Short-Run Competitive Industry Supply Curve

• Or consider the case where $n$ identical firms each have supply curve $Q_i = -\frac{c}{d} + \frac{1}{d} P$, as from $P = c + dQ_i$

• Industry supply $Q = nQ_i = -\frac{nc}{d} + \frac{n}{d} P$, which gives $P = c + \frac{d}{n} Q$.

• If 200 firms all have individual supply $P = 100 + 1000Q_i$, then industry supply $P = 100 + 5Q$. 

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Short-Run Price and Output Determination

• For Figure 10.6, suppose the market price, at the intersection of supply and demand, is $P = 20$.

• For a representative firm, $P = MC$ at $Q_i = 80/wk$.

• Average total cost ($ATC = TC/Q$) for quantity $80/wk$ is $ATC = 12$.

• Profit for the firm is $TR – TC = (P – ATC)Q_i = (20 – 12)80 = 640/wk$ (shaded green area).
Figure 10.6: Short-Run Price and Output Determination under Pure Competition
Short-Run Price and Output Determination

• For Figure 10.7, suppose the market price, at the intersection of supply and demand, is \( P = $10 \) and \( P = MC \) at \( Q_i = 60/wk. \)
  
  – Average total cost (\( ATC = TC/Q \)) for quantity 60/wk is \( ATC = $12. \)

• Profit for the firm is \( TR - TC = (P - ATC)Q_i = (10 - 12)60 = -$120/wk \) (lose green shaded area).

• \( P = 10 \) is above minimum of \( AVC \) so produce 10 rather than shutting down and producing zero.
Figure 10.7: A Short-Run Equilibrium Price that Results in Economic Losses

Market

\[ P^* = 10 \]

\[ Q^* \]

\[ S = \Sigma MC \]

\[ D \]

\[ P = M R_i = 10 \]

\[ \Pi_i = -$120/wk \]

Individual Firm

\[ Q_i \]

\[ 60 \]

\[ 10 \]

\[ 12 \]

\[ \text{Units of output/wk} \]

\[ \text{Price ($/unit of output)} \]

\[ \text{Price ($/unit of output)} \]

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Short-Run Competitive Equilibrium

• Even though the market demand curve is downward sloping, the demand curve facing the individual firm is perfectly elastic, a straight horizontal line at the market price.

• *Breakeven point:* the point at which price equal to the minimum of average total cost.
  – The lowest price at which the firm will not suffer negative profits in the short run.
Figure 10.8: The Efficiency Of Short-run Competitive Equilibrium

- **Allocative efficiency**: a condition in which all possible gains from exchange are realized.
Producer Surplus

• A competitive market is efficient when it maximizes the net benefits to its participants.

• **Producer surplus:** the dollar amount by which a firm benefits by producing a profit-maximizing level of output.
Figure 10.9: Two Equivalent Measures of Producer Surplus
Figure 10.10: Aggregate Producer Surplus When Individual Marginal Cost Curves are Upward Sloping Throughout
Figure 10.11: The Total Benefit from Exchange in a Market
Producer and Consumer Surplus in a Careful Fireworks Users Market

• For Figure 10.12, 1000 firms have $MC_i = 10 + Q_i$. Demand from careful fireworks users is $P = 50 - 0.001Q$.
• Industry supply $P = 10 + 0.001Q$. Equilibrium $P = 30$ and $Q = 20,000$.
• Total surplus 400,000, the sum of consumer and producer surplus

$$CS = (50 - 30) \frac{20,000}{2} = 200,000$$

$$PS = (30 - 10) \frac{20,000}{2} = 200,000$$
Figure 10.12: Producer and Consumer Surplus in a Market Consisting of Careful Fireworks Users

\[ S = \Sigma MC = 10 + 0.001Q \]
Figure 10.13: A Price Level that Generates Economic Profit

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Adjustments In The Long Run

• Positive economic profit creates an incentive for outsiders to enter the industry.
• As additional firms enter the industry the industry supply curve to the right.
• This adjustment will continue until these two conditions are met:
  1. Price reaches the minimum point on the LAC curve
  2. All firms have moved to the capital stock size that gives rise to a short-run average total cost curve that is tangent to the LAC curve at its minimum point.
Figure 10.14: A Step along the Path Toward Long-Run Equilibrium
Figure 10.15: The Long-Run Equilibrium under Perfect Competition
The Invisible Hand

• Why are competitive markets attractive from the perspective of society as a whole?
  – Price is equal to Marginal Cost.
    • The last unit of output consumed is worth exactly the same to the buyer as the resources required to produce it.
  – Price is equal to the minimum point on the long-run average cost curve.
    • There is no less costly way of producing the product.
  – All producers earn only a normal rate of profit.
    • The public pays not a penny more than what it cost the firms to serve them.
The Long-Run Competitive Industry Supply Curve

- **Constant cost Industries:** long-run supply curve is a horizontal line at the minimum value of the LAC curve.
- **Increasing cost industries:** long-run supply curve is upward sloping.
- **Decreasing cost industries:** long-run supply curve is downward-sloping.
Figure 10.16: The Long-Run Competitive Industry Supply Curve
Figure 10.17: Long-Run Supply Curve for an Increasing Cost Industry
Figure 10.19: The Elasticity Of Supply

- **Price elasticity of supply**: the percentage change in quantity supplied that occurs in response to a 1 percent change in product price.
Figure 10.22: The Effect of a Tax on the Output of a Perfectly Competitive Industry
Problem 1

1. If the short-run marginal and average variable cost curves for a competitive firm are given by $SMC = 2 + 4Q$ and $AVC = 2 + 2Q$, how many units of output will it produce at a market price of 10? At what level of fixed cost will this firm earn zero economic profit?
Solution 1

1. Maximize profit by producing quantity such that \( P = MC \). In this case \( P = 10 \) and \( MC = 2 + 4Q \), so pick \( Q \) to make \( 10 = 2 + 4Q \) and thus \( Q = 2 \). Profit is \( TR - TC = PQ - (AVC)Q - FC \). \( P = 10 \) and \( Q = 2 \) so \( TR = PQ = 20 \). \( AVC = 2 + 2Q = 2 + 2(2) = 6 \). \( TC = (AVC)Q + FC = (6)2 + FC = 12 + FC \). Profit is \( TR - TC = 20 - 12 - FC = 8 - FC \). At a FC of 8, the firm would earn zero profit.
Problem 2

2. The marginal and average cost curves of taxis in Metropolis are constant at $0.20/mile. The demand curve for taxi trips in Metropolis is given by $P = 1 - 0.00001Q$, where $P$ is the fare, in dollars per mile, and $Q$ is measured in miles per year. If the industry is perfectly competitive and each cab can provide exactly 10,000 miles/yr of service, how many cabs will there be in equilibrium and what will be the equilibrium fare?
Solution 2

2. Price must match the constant marginal cost of $0.20/mile. The supply curve is a horizontal straight line at $P = $0.20/mile. Equilibrium quantity can be solved from the intersection of supply and demand $0.20 = 1 - 0.00001Q$ or $0.00001Q = 0.8$ so $Q = 80,000$. With each cab providing 10,000 miles/yr of service, there will be 8 cabs in equilibrium, each charging $P = $0.20/mile.
Problem 3

3. Now suppose that the city council of Metropolis decides to curb congestion in the downtown areas by limiting the number of taxis to 6. Applicants participate in a lottery, and the six winners get a medallion, which is a permanent license to operate a taxi in Metropolis. What will the equilibrium fare be now? How much economic profit will each medallion holder earn? If medallions can be traded in the marketplace and the rate of interest is 10 percent/yr, how much will the medallions sell for? Will the person who buys a medallion at this price earn a positive economic profit?
Solution 3

3. Six taxis would supply $6(10,000) = 60,000$ mi/yr.

$P = 1 - 0.00001Q = 1 - 0.00001(60,000) = 1 - 0.6 = 0.4$ so the equilibrium fare will rise to $0.40$/mile.

Each medallion holder will earn an economic profit of $(0.40 - 0.20)10,000 = 2,000$. At an interest rate of 10 percent, medallions would sell $2,000/0.1 = 20,000$. Someone who buys a medallion at this price will earn zero economic profit: $20,000$ for a medallion would generate $2,000$/yr, the same as putting the money in a bank at 10% interest.
Problem 4

4. A firm in a competitive industry has a total cost function of $TC = 0.2Q^2 + 5Q + 30$, whose corresponding marginal cost curve is $MC = 0.4Q + 5$. If the firm faces a price of 6, what quantity should it sell? What profit does the firm make at this price? Should the firm shut down?
4. A firm in a competitive industry has a total cost function of \( TC = 0.2Q^2 + 5Q + 30 \), whose corresponding marginal cost curve is \( MC = 0.4Q + 5 \). Setting \( P = MC \) with \( P = 6 \) and \( MC = 0.4Q + 5 \), \( 6 = 0.4Q + 5 \), so \( Q = 2.5 \). Total revenue is \( TR = PQ = 6(2.5) = 15 \). Total cost is \( TC = 0.2Q^2 + 5Q + 30 = 0.2(6.25) + 5(2.5) + 30 = 1.25 + 12.5 + 30 = 33.75 \). Profit at this price is \( TR - TC = 15 - 33.75 = -18.75 \). No the firm should not shut down because its profits for \( Q = 2.5 \), while negative, are not as bad as losing fixed cost of 30 if were to produce nothing.