Partial Equilibrium Analysis

- We have now analyzed the intricate workings of market supply and demand curves from the bottom up.
- Today, we will put together these curves to predict the equilibrium price in one market (“partial” equilibrium) in the long and short run.
- We will consider how government policies affect the welfare of market participants in this model.

Equilibrium is the Intersection of Supply and Demand Curves

Price Setting

- Prices are set by the interaction of all market participants
- From the point of view of each market participant, prices are fixed at the equilibrium level.
  - This is true as long as suppliers have no market power (perfect competition).
- Prices will move toward equilibrium.
  - If prices are above equilibrium: supply expands, demand contracts.
  - If prices are below equilibrium: supply contracts, demand expands.

Supply and Demand Elasticities

- It is useful to have a measure of the responsiveness of supply and demand to price that is unitless—elasticity.
- Definition: Supply elasticity
  \[ e_{s,P} = \frac{\% \text{ change in } Q \text{ supplied}}{\% \text{ change in } P} = \frac{\partial Q_s}{\partial P} \frac{P}{Q_s} \]
- Definition: Demand elasticity
  \[ e_{d,P} = \frac{\% \text{ change in } Q \text{ demanded}}{\% \text{ change in } P} = \frac{\partial Q_d}{\partial P} \frac{P}{Q_d} \]
Welfare Properties of Partial Equilibrium

Comparative Statics of Equilibrium

- Comparative statics is the study of how equilibrium changes when some exogenous event occurs.
- Example: What happens to the price of Nikes if people start to boycott them?
- Let the demand for Nikes be \( Q_D = F(P, a) \) where \( a \) is a “sweatshop fad” parameter so that \( \frac{\partial Q_D}{\partial a} < 0 \).

Comparative Statics (continued)

- Let the supply of Nikes be \( Q_S = G(P) \)
- Take the total differential of both supply and demand:
  \[
  dQ_D = \frac{\partial Q_D}{\partial P} dP + \frac{\partial Q_D}{\partial a} da
  \]
  \[
  dQ_S = \frac{\partial Q_S}{\partial P} dP
  \]

Comparative Statics (continued)

- In equilibrium, the change in quantity demanded and supplied (due to the fad) should be equal to each other.
- \( dQ_D = dQ_S \)
- Therefore,
  \[
  \frac{\partial Q_D}{\partial P} dP = \frac{\partial Q_D}{\partial P} dP + \frac{\partial Q_S}{\partial a} da
  \]

Comparative Statics (continued)

- Long Run vs. Short Run Supply Response
- In the short run, the market supply curve is inelastic.
  - Firms are unable to change the level of many fixed factors of production in response to a change in prices.
  - New firms cannot enter the market in the short run.
- In the long run, the competitive market supply curve is elastic.
  - Firms enter.
  - Firms adjust their input mix. Firms produce at the minimum point of their average cost curve.

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Long Run vs. Short Run
Demand shifts out. Supply is inelastic in the short run. Supply rotates and becomes more elastic in the long run; price moves back toward the old equilibrium.

Long Run Supply in a Competitive Market
- In the long run, firm entry into a competitive market will drive profits to zero for each firm:
  \[ \pi = PQ - TC(Q) = 0 \]
  \[ P = \frac{TC(Q)}{Q} = AC(Q) \]

Firm Entry, Costs, and Interaction Between Firms
- It is possible that when more firms enter an industry, this can affect the costs of existing firms.
  - Competition for high skilled labor could drive up labor and total costs.
  - More firms working in an industry may facilitate non-proprietary technological breakthroughs (which lower costs).

Constant Costs Case and Long Run Supply
- If there are a large number of firms in an industry, the entry of one firm often will have no effect on the costs of other firms (constant costs case).
- Under constant costs in a perfectly competitive industry, long run supply will be perfectly elastic.
  - But in the constant costs case, the entry of new firms does not change this cost curve.
  - This, in turn, implies that each firm’s optimum output level does not change in the long run.
  - Firms will enter until profits are driven to zero, which will be at some constant price (since costs are also constant by assumption).

Nicholson Example Problem
- Suppose that the long-run total cost function for the typical mushroom producer is given by \( TC = wq^2 - 10q + 100 \), where \( q \) is the output of the typical firm and \( w \) represents the hourly wage rate of mushroom pickers. Suppose the demand for mushrooms is \( Q = -1,000P + 40,000 \), where \( Q \) is total quantity demanded and \( P \) is the market price.
Example—Part (a)

- If the wage rate is $1, what will be the long-run equilibrium output for the typical mushroom picker?
- In the long run, \( P = AC \) because of firm entry.
- Profit maximization implies \( P = MC \), so \( MC = AC \).
- In this case: \( MC = 2wq - 10 \), \( AC = wq - 10 + \frac{100}{q} \).

Solution to Part (a)

For each firm in business in the long run:

\[
2wq - 10 = wq - 10 + \frac{100}{q}
\]

\[
wq^2 = 100
\]

\[
q = \frac{100}{w} = \sqrt{100w}
\]

Example—Part (b)

- Assuming that the mushroom industry exhibits constant costs and that all firms are identical, what will be the long run equilibrium price of mushrooms, and how many mushroom firms will there be?
- Under the constant costs assumption, the long run supply curve is perfectly elastic.

Solution to (b)

- \( P = MC = 2wq - 10 = 20\sqrt{w} - 10 \)
- At \( P \), demand and supply are in equilibrium, so the quantity sold (\( Q \)) is 40000-1000(20\sqrt{W} - 10):

\[
Q = 40000 - 1000(20\sqrt{W} - 10)
\]

- Since each firm produces \( q \), the number of firms in the industry in equilibrium (\( n \)) is:

\[
r = \frac{Q}{q} = \frac{40000 - 1000(20\sqrt{W} - 10)}{10/\sqrt{W}} \approx 5000\sqrt{w} - 2000w
\]

Example—Part (c)

- Suppose the government imposed a tax of $3 for each mushroom picker hired, raising wages to $4. Assuming the TC curve retains its shape, how will \( q \), \( P \), and \( Q \) change?
- This is easy to answer given the solution to parts (a) and (b)—just plug in for \( w \).

Taxes in Partial Equilibrium

- Suppose that the government imposes a tax on sales of some commodity.
  - Who ultimately pays the tax—to what extent do consumers pay vs. producers?
  - What are the welfare effects of the tax?
- The imposition of the tax (\( t \)) drives a wedge between the price received by firms (\( P_r \)) and the price paid by consumers (\( P_c \)):

\[
t = P_r - P_c
\]
Who Pays Most for the Tax?

- The demand curve is given by $Q_d = F(P_d)$.
- The supply curve is given by $Q_s = G(P_s)$.
- The equilibrium condition is still $Q_s = Q_d$.
- Totally differentiating these yields:
  \[ dQ_s = \frac{\partial Q_s}{\partial P} dP_s \quad dQ_d = \frac{\partial Q_d}{\partial P} dP_d \]
  \[ dQ_s = dQ_d \quad dt = dP_d - dP_s \]

Tax Incidence (continued)

- Solving these equations simultaneously yields:
  \[ \frac{dP_s}{dt} = \frac{e_{s,p}}{e_{s,p} - e_{d,p}} \quad \frac{dP_d}{dt} = \frac{e_{d,p}}{e_{s,p} - e_{d,p}} \]
- In terms of price elasticities:

Tax Incidence (continued)

- The tax falls most on consumers if demand is inelastic.
- The tax falls most on producers if supply is inelastic.

Welfare Loss from Taxation

\[ \begin{align*}
\text{Consumer Surplus} & = \frac{1}{2} (P_d - e_{s,p} P_d^2) \\
\text{Producer Surplus} & = \frac{1}{2} (P_s - e_{d,p} P_s^2) \\
\text{Triangle welfare loss from taxation} & = \frac{1}{2} (P_d - P_s) (Q_d - Q_s)
\end{align*} \]

Minimum Price Regulation

- If the minimum price regulation is below the equilibrium price, the regulation is not binding and the equilibrium price holds.
- If it is above the equilibrium price, the regulation is binding.
  - It creates a wedge between quantity supplied in equilibrium and quantity demanded which results in excess supply.
  - Consumer surplus shrinks.
  - Producer surplus may shrink or grow.
  - Total surplus shrinks.