Market structure 1: Perfect Competition

- Consider market for a single good.
- The perfectly competitive firm is a **price taker**: it cannot influence the price that is paid for its product.
- This arises due to consumers’ indifference between the products of competing firms → for example, buy from store with lowest price. Consumers’ indifference arises from:
  - Product homogeneity
  - Consumers have perfect information
  - No transactions cost
  - Many firms
- PC firm faces horizontal demand curve at market price $p$
PC firm’s profit maximization problem

- \( \max_q \pi(p) = pq - C(q) \)
- First-order condition: \( p = C'(q) = MC(q) \)
- Second-order condition: \( C''(q) > 0 \), satisfied if \( MC(q) \) is an increasing function
- If \( p \uparrow \), production rises along \( MC(q) \) curve: \( MC(q) \) is the “supply curve” of the firm.
A firm produces only when its profits from producing exceed the costs it would avoid by not producing.

**In short-run**: avoidable costs do not include sunk costs. Shut down when revenues fall short of avoidable costs $\iff pq < \text{Avoidable costs}(q)$. Consider two cases:

1. All fixed costs are sunk. Avoidable costs $= VC(q)$: shut down once $p < AVC(q) (< AC(q))$.
2. Proportion $\alpha$ of fixed costs not sunk. Avoidable costs $= VC(q) + \alpha F$: shut down once $p < AVC(q) + \frac{\alpha F}{q}$.

**In long-run**: avoidable costs include sunk cost. Shut down when $pq < C(q) \iff p < AC(q)$.

Short-run supply curve? Long-run supply curve? Graph.
In the short run:

- Number of firms fixed
- Industry supply curve: sum of individual firms’ short-run supply curves. Zero supply at prices below shutdown point. Graph.
- Industry demand curve: downward sloping. Graph.
- Price determined by intersection of industry demand and supply curves. Graph.
- In short-run equilibrium: positive profits for each firm as long as $p > AC(q)$. 
Perfect competition

The perfectly competitive industry: Long-run

- Number of firms can vary
- **Free entry and exit:**
  Any short-run profits soaked up by new firms in long-run $\implies$ Price is driven down to the minimum of the AC curve
- Long-run industry supply curve: horizontal at minimum of the average cost curve
  LR supply curve may be upward-sloping if min AC is rising in market demand $Q$ (due, for example, to resource scarcity)
Elasticities and the residual demand curve

Can downward-sloping industry demand curve and horizontal firm-level demand curve coexist?

- Price elasticity of demand:
  \[ 
  \epsilon \equiv \frac{\Delta q(p)}{\Delta p} \frac{p}{q} = \frac{\partial \log q(p)}{\partial \log p} = \frac{\partial q(p)}{\partial p} \frac{p}{q(p)}
  \]

  Steep demand curves are inelastic
  Flat demand curves are elastic

- Residual demand: \( D_r(p) = D(p) - S_o(p) \).

- At competitive equilibrium, firm \( i \)'s residual demand elasticity is:
  \[ 
  \epsilon_i = \epsilon n - \eta_0(n - 1)
  \]
  where \( \eta_0 \) is the “residual supply” elasticity:
  \[ 
  \eta_0 = \frac{\partial S_0(p)}{\partial p} \frac{p}{S_0(p)}
  \]

- Inelastic industry demand (low \(|\epsilon|\)) consistent with elastic residual demand curve (high \(|\epsilon_i|\)) as \( n \) increases

Example
  - market demand \( Q = 100 - p \)
  - 50 firms, each with supply curve \( q = p \)
Perfect competition

Desirability of PC outcome

\[ p = MC(q) = \min_q AC(q) \]

- Production at \( p = MC(q) \): firm produces an additional unit only if it can cover the production costs. *Producer surplus* is maximized.

- Value placed on marginal unit of the good \( p \) exactly equals the cost of producing that marginal unit (*consumption efficiency*). *Consumer surplus* is maximized.

- Production at minimum average cost: no better alternative use of resources is possible (*production efficiency*). In other words, each firm operating at minimum efficient scale.
General equilibrium

Consider the general case with multiple goods, and heterogeneous firms and agents.

All agents are price takers.

Given prices, consumers choose how much of each good to buy in order to maximize their welfare, given that their expenditures must not exceed their income. This gives rise to demand functions.

Given prices, producers choose production plans to maximize profits given their technological possibilities, giving rise to supply functions.

A competitive equilibrium is a set of prices, with associated demands and supplies, such that all the markets clear.
Welfare Theorems

- Weak assumptions about preferences and technological possibilities yield general results on competitive equilibrium.

- 1st Welfare Theorem: A competitive equilibrium is Pareto Optimal. A benevolent social planner can’t improve on the competitive allocation.

- 2nd Welfare Theorem: Any Pareto-optimal allocation can be decentralized by a choice of the right prices and an appropriate redistribution of income among consumers.
  - Requires convexity assumptions that rule out increasing returns to scale.

- Key property of competitive equilibrium: each good is sold at marginal cost. Prices induce consumers to internalize the (social) cost of producing an additional unit of the good.
Nice outcome in perfect competitive world depends crucially on free-entry assumption. Fixed costs of entry are present in many markets: are they a barrier to entry??

- Fixed costs borne equally by all firms: accommodated by free entry assumption
  Example: salt factory, advertising?
- Fixed costs which affect entrant firms disproportionately: barriers to entry
  “First mover advantage”: incumbent muddies waters to make subsequent entry difficult.
  Ex: \( C_1(q) = F + VC(q) \), \( C_2(q) = 2F + VC(q) \)
  Microsoft: computer operating systems?
  Apple: iPad?

Next focus on extreme case where entry ruled out: monopoly
Market structure 2: Monopoly

- Industry has one firm, who faces downward-sloping industry demand curve
- **Market power**: ability of a firm to dictate market prices in an industry. Depends on the slope of the residual demand curve.
- Market power is “opposite” of price-taking behavior
Monopoly and profit maximization

Two equivalent formulations:
First, monopolist chooses quantity to maximize profits

\[ \max_q p(q)q - C(q) = \text{Revenue}(q) - C(q) \]

Graph. Quantity can be increased only if price is lower. Tradeoff between increased demand versus revenue lost on consumers who would have bought even under the higher price

FOC: \[ R'(q)) = p(q) + p'(q)q = C'(q) \leftrightarrow MR(q) = MC(q). \] Graph.
Monopoly and profit maximization

Alternatively, monopolist chooses price to maximize profits

\[ \max_p pq(p) - C(q(p)), \text{ where } q(p) \text{ is demand curve.} \]

FOC: \( q(p) + pq'(p) = C'(q(p))q'(p) \)

At optimal price \( p^* \), Inverse Elasticity Property holds:

\[ (p^* - MC(q(p^*))) = -\frac{q(p^*)}{q'(p^*)} \text{ or } \frac{p^* - mc(q(p^*))}{p^*} = -\frac{1}{\epsilon(p^*)}, \text{ where } \epsilon(p^*) \text{ is} \]

\[ q'(p^*)\frac{p^*}{q(p^*)}. \]

Across monopolistic markets, should observe negative relationship between price and demand elasticity

If \( \epsilon \to +\infty \): \( p = MC(q) \)
**Inverse Elasticity condition**

- \( \frac{p^* - mc(q(p^*))}{p^*} = -\frac{1}{\epsilon(p^*)} \),
- What if \(-1 < \epsilon(p^*) < 0\)? Implies \(p^* < mc\), which is nonsensical.
- Unpack marginal revenue expression:

\[
MR(q) = \frac{\partial R(q)}{\partial q} = p'(q)q + p(q) = \frac{q(p)}{q'(p)} + p = p \left( \frac{1}{q'(p)} \frac{q(p)}{p} + 1 \right) = p \left( \frac{1}{\epsilon(p)} + 1 \right)
\]

which is negative for prices where \(-1 < \epsilon(p) < 0\). (Use \(p'(q) = 1/q'(p)\)).
- More intuitive: monopolist never chooses a \(p\) (or equivalently \(q(p)\)) where its marginal revenue would be negative.
- From this perspective, the cause of the socially too low quantity produced is the monopolist’s recognition that a reduction in the quantity it sells allows it to increase the price on all the **intramarginal units**.

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**EC 105. Industrial Organization (Matt Shum HSS, California Institute of Technology)**

**Lecture 2: Market Structure I (Perfect Competition and Monopoly)**

**October 1, 2012**
Dead-Weight Loss

- Markup provides a quantification of price distortion, and is useful for policy purposes (later). This is not, however, an appropriate measure of distortion from a normative viewpoint. Instead, the appropriate measure is the loss of social welfare.

- To measure the later we compare the total surplus (consumer and producer surplus, or profit) at the monopoly price with that at the competitive (marginal cost) price.
Dead-Weight Loss
Dead-Weight Loss

- The welfare loss does not necessarily decrease with the elasticity of demand, even though the relative markup does.

- Strong price distortions correspond to low demand elasticities

- Consumers decrease their quantity demanded only slightly in response to a unit price increase.

- In precisely these situations, price changes do not affect quantity consumed very much; rather, they elicit a large transfer from consumers to the firm.
How monopolies arise

Crucial aspect of monopoly: price-setting ability (relatively inelastic demand curve)

- Product differentiation: Apple vs. Samsung vs. RIM
- Superior production technology
- Government-granted monopolies (patents)
Positive aspects of monopoly?

- Demsetz critique: monopolist is the firm with lowest-cost technology. Monopolist “deserves” its market leadership.

- Schumpeter: monopoly profits provide an incentive for innovation and technological change ("process of creative destruction")

- Natural monopoly: industry characterized by increasing returns to scale.

- Government antitrust policy: balance these aspects

- Checks on a monopolist’s market power: threat of entry keeps price around average cost
Recall definition of market power: ability to profitably charge a price above perfectly competitive levels. Discretion as to what “too much” market power is.

- Market share. Small firms can’t have any market power. Not true: makers of “niche products” (ie. Apple Mac) have a lot of market power!

- Availability of substitutes to monopolist’s product: but perhaps (possibly cost-inefficient) substitutes only available when monopolist charges \( p > MC \). **Cellophane fallacy** \( \rightarrow \) availability of substitutes is sign of market power!

- Direct measure of market power is given by estimates of *demand elasticities*, which are inversely related to profit-maximizing price-cost margin. Examples (handout)
Summary

1. Perfect competition
   - Individual firm takes prices as given in making output decisions
   - Shutdown decisions: long run vs. short run
   - Industry equilibrium: in long-run \( p = MC(q) = \min_q AC(q) \)

2. Monopoly
   - Firm has power to set both quantity and price
   - Tradeoff between higher demand but lower per-unit prices
   - \( MR(q^*) = MC(q^*) \); inverse-elasticity pricing property