Block 9: The Labour Market

Factors of Production

The main factors of production are:

- **Land:** All free gifts of nature (land, forests, minerals). Supply is generally fixed, even in the long run.
- **Labour:** Mental and physical effort of people employed for remuneration. Individual skills and qualifications constitute human capital.
- **Physical Capital:** Stock of produced goods used in production. It can be increased and depreciates over time.

Other factors sometimes included are raw materials (fully consumed in production) and entrepreneurship (innovation and risk-taking).

Firm's Demand for Inputs

Long Run

In the long run, firms can vary all inputs. An increase in the price of labor (wage rate) decreases labor demand due to:

- **Substitution effect:** Capital becomes relatively cheaper.
- **Output effect:** Higher costs reduce the profit-maximizing output level.

The elasticity of demand for the firm's output affects the output effect; less elastic demand implies a smaller output effect of a wage increase.

Short Run

In the short run, at least one factor is fixed. Labor is subject to diminishing marginal returns when other factors are fixed. The firm hires labor until:

$$\text{Marginal Cost of Labor (MCL)} = \text{Marginal Revenue Product of Labor (MRPL)}$$

For a price-taking firm:

$$\text{MRPL} = \text{Price of Output} \times \text{Marginal Product of Labor (MPL)}$$

For a firm with market power:

$$\text{MRPL} = \text{Marginal Revenue (MR)} \times \text{MPL}$$

The optimal rule for hiring labor is to hire until:

$$W = \text{MRPL} = \text{MR} \times \text{MPL}$$

For a competitive firm where price = marginal revenue ($MR = P$):

$$W = P \times \text{MPL}$$

For a firm with market power (e.g., a monopolist):

$$W = P\left(1 + \frac{1}{\epsilon}\right) \times \text{MPL}$$

where ϵ is the price elasticity of demand for output. Note that because ϵ is negative, the labor demand curve for a non-competitive firm lies below the labor demand curve for a competitive firm with the same MPL curve and is steeper.

Industry Demand for Labor

The industry demand curve for labor is steeper than the horizontal sum of individual firms' short-run demand curves. This is because lower wages increase industry output, leading to a fall in the output price and shifting the firms' curves.

Labor Supply Decisions

Labor supply depends on:

- Population size
- Participation rate (fraction of working-age population in the labor force)
- Hours worked by each individual in the labor force

A rise in the real hourly wage has a substitution effect (increasing hours worked) and an income effect (reducing hours worked). The four main factors that increase the participation rate are: higher real wages, lower fixed costs of working, lower non-labor income, and changes in tastes favoring work.

Economic Rent

Economic rent is the payment to a worker in excess of their reservation wage (the lowest wage they'd accept). Graphically, it's the area above the labor supply curve and below the equilibrium wage.

Labor Market Equilibrium and Disequilibrium

Labor market equilibrium occurs when labor demand equals labor supply. Disequilibrium (unemployment) can arise from:

- Minimum wages
- Trade unions
- Scale economies
- Insider-outsider distinctions
- Efficiency wages (paying above-equilibrium wages to increase productivity)

Minimum Wages and Unemployment

Minimum wage laws can create unemployment by setting wages above the equilibrium level. The extent depends on the elasticity of labor supply and demand.

Block 8: Market Structure and Imperfect Competition

Imperfect Competition, Oligopoly, and Monopolistic Competition

Imperfect competition refers to any market structure where firms face a downward-sloping demand curve, indicating they have some market power. **Oligopoly** is a specific type of imperfect competition characterized by a small number of firms that interact strategically. Each firm's actions affect its rivals, and its optimal choices depend on its rivals' actions. **Monopolistic competition** is another type of imperfect competition with many firms, each selling a differentiated product. Product differentiation creates some degree of market power for each firm.

Cost and Demand's Influence on Market Structure

The relationship between cost and demand determines market structure. The key concept is **minimum efficient scale** (MES), the lowest output level where LRAC is minimized. If MES is small relative to market demand, many firms can operate efficiently, leading to monopolistic competition or even perfect competition. If MES is large relative to market demand, only a few firms can operate efficiently, resulting in an oligopoly or monopoly.

N-Firm Concentration Ratio

The **N-firm concentration ratio** measures the proportion of total industry output produced by the N largest firms. It is used to quantify market concentration. A high concentration ratio suggests less competition.

Equilibrium in Monopolistic Competition

In monopolistic competition, the long-run equilibrium occurs where each firm's demand curve is tangent to its average cost (AC) curve. Firms earn zero economic profit (covering only opportunity costs) because free entry and exit eliminate any economic rents. The equilibrium is not at the minimum of the AC curve, indicating inefficiency.

Collusion and Competition in a Cartel

A **cartel** is a group of firms that collude to restrict output and raise prices, mimicking a monopoly. The tension exists because while firms benefit collectively from collusion (higher profits), each firm has an incentive to cheat and produce more than agreed to capture a larger market share. This is often modeled using game theory.

Game Theory and Strategic Behavior

Game theory is a tool used to analyze strategic interactions between firms (or other players). Key concepts include:

- **Dominant strategy:** A strategy that is best for a player regardless of what the other player does.
- **Nash equilibrium:** A situation where no player has an incentive to change its strategy given the strategies of other players.

Simultaneous Games and Nash Equilibria

Simultaneous games (one-shot games) are games where players choose their actions at the same time. The Nash equilibrium is found by identifying the best response for each player given the other player's action. The intersection of the best responses constitutes the Nash equilibrium.

Sequential Games and Backwards Induction

In **sequential games**, players move in a specific order. **Backwards induction** is a solution method that starts from the last stage of the game and works backward to determine optimal strategies at each stage. It is often illustrated using a decision tree.

Reaction Functions and Nash Equilibrium

Reaction functions describe how a firm's optimal choice depends on its rival's action. In a duopoly (two firms), each firm's reaction function expresses its profit-maximizing output

as a function of the rival firm's output. The Nash equilibrium is the point where these functions intersect—the output levels where each firm's choice is a best response to the other's.

Cournot and Bertrand Competition

- **Cournot competition:** Firms compete by choosing quantities simultaneously. The Nash equilibrium is found using reaction functions.
- **Bertrand competition:** Firms compete by choosing prices simultaneously. In this case, the Nash equilibrium is often where prices equal marginal cost.

The Cournot Model: Formulas and Derivations

The Cournot model analyzes a duopoly (two firms) where firms compete by simultaneously choosing their output levels. Here's a derivation of the key formulas, assuming linear demand and constant marginal costs:

- **Market demand curve:** $P = a - bQ$, where P is the price, Q is the total market quantity, a is the price intercept, and b is the slope ($b > 0$). The total quantity is the sum of the quantities produced by the two firms: $Q = Q_A + Q_B$.
- **Constant Marginal Cost:** Each firm has a constant marginal cost, c. We assume $c < a$ for the model to be meaningful.
- **Profit Maximization:** Firms maximize profit where $\pi = TR - TC$, where TR is total revenue and TC is total cost.

Derivation of Reaction Functions

Firm A:

$$TR_A = P \cdot Q_A = (a - b(Q_A + Q_B))Q_A = aQ_A - bQ_A^2 - bQ_AQ_B$$

$$MR_A = \frac{\partial TR_A}{\partial Q_A} = a - 2bQ_A - bQ_B$$

$$\text{Set } MR_A = MC_A \implies a - 2bQ_A - bQ_B = c$$

$$\text{Solve for } Q_A: \quad Q_A = \frac{a-c}{2b} - \frac{Q_B}{2}$$

Firm B:

$$Q_B = \frac{a-c}{2b} - \frac{Q_A}{2}$$

Nash Equilibrium

At equilibrium, $Q_A = Q_B = Q^*$. Solving the symmetric reaction functions:

$$Q^* = \frac{a-c}{3b}$$

Equilibrium Price

$$P^* = a - b(Q_A^* + Q_B^*) = a - b\left(\frac{2(a-c)}{3b}\right) = \frac{a+2c}{3}$$

Stackelberg Leadership

In **Stackelberg competition**, one firm (the leader) moves first and chooses its output, followed by the other firm (the follower) choosing its output given the leader's output. The leader has a first-mover advantage and gets higher profits than in Cournot competition. The follower has lower profits than in Cournot competition.

Block 7: Pure Monopoly

Definition of Pure Monopoly

A pure monopoly exists when there is only one firm in a market, and it serves as the sole supplier of a good or service with no close substitutes. Additionally, there are high barriers to entry, preventing other firms from entering the market. Examples include utilities like water supply and firms protected by patents.

Finding the Optimal Price and Output for a Monopolist

A monopolist maximizes profit by producing the quantity of output where marginal cost (MC) equals marginal revenue (MR). Unlike a perfectly competitive firm, a monopolist faces a downward-sloping market demand curve, meaning:

$$MR < P \quad \text{(price exceeds marginal revenue at all positive output levels).}$$

To find the profit-maximizing output:

1. Identify the demand curve $\big(P = f(Q)\big)$.
2. Derive the total revenue $\big(TR = P \times Q\big)$.
3. Compute marginal revenue $\big(MR = d(TR)/dQ\big)$.
4. Equate $MR = MC$ and solve for Q^* (optimal quantity).
5. Determine the corresponding price P^* from the demand curve.

Relationship Between PED and Monopoly Power

The monopolist's ability to set a price above marginal cost depends on the price elasticity of demand (PED). The Lerner Index, a measure of monopoly power, is defined as:

$$L = \frac{P - MC}{P} = -\frac{1}{PED},$$

where: - $PED < -1$: Elastic demand, limited pricing power. - $-1 < PED < 0$: Inelastic demand, greater pricing power.

Comparison: Monopoly vs Perfect Competition

Under perfect competition:

- Price equals marginal cost ($P = MC$), leading to allocative efficiency.
- Output (Q_c) is higher, and price (P_c) is lower.

Under monopoly:

- Price exceeds marginal cost ($P > MC$), causing allocative inefficiency.
- Output (Q_m) is lower, and price (P_m) is higher.
- Deadweight loss represents the loss in total surplus due to monopoly power.

Price Discrimination and Its Effects

Price discrimination occurs when a monopolist charges different prices for the same good to different consumers or groups. There are three types:

1. **First-degree (perfect price discrimination):** The monopolist charges each consumer their maximum willingness to pay. Output increases to the level of perfect competition, and the monopolist captures all consumer surplus.
2. **Second-degree price discrimination:** Prices vary based on the quantity purchased (e.g., bulk discounts). Consumer surplus is partially captured.
3. **Third-degree price discrimination:** Prices differ across identifiable groups with different demand elasticities (e.g., student discounts). Output and profits depend on group elasticities.

Effects:

- **Output:** Generally increases compared to uniform pricing, as more consumers are served.
- **Profits:** Increase as the monopolist captures additional consumer surplus.

Natural Monopoly and Regulation

A natural monopoly arises when a single firm can produce the market output at a lower cost than multiple firms due to economies of scale. Its long-run average cost ($LRAC$) curve slopes downward over the relevant range of output.

Regulatory responses include:

- **Price capping:** Limiting the price to prevent excessive monopoly profits.
- **Marginal cost pricing:** Forcing the monopolist to set $P = MC$, though this may require subsidies to cover losses.

Social Cost of Monopoly

Monopolies lead to:

- **Allocative inefficiency:** $P > MC$, meaning not all mutually beneficial trades occur.
- **Deadweight loss:** The loss of consumer and producer surplus due to reduced output.

Despite inefficiency, monopoly profits can incentivize innovation, as firms invest in research and development to maintain or acquire monopoly status.

Block 6: Perfect Competition

Definition of Perfect Competition

Perfect competition is a market structure characterized by the following assumptions:

- **Many firms:** A large number of firms, each negligible in size relative to the entire industry.
- **Homogeneous goods:** All firms produce identical products, making them perfect substitutes.
- **Perfect information:** Buyers and sellers are fully informed about prices and available alternatives.
- **Free entry and exit:** Firms can freely enter or exit the market in the long run.

These assumptions lead to the key implication that individual firms are **price takers**, facing a horizontal demand curve where $P = AR = MR$.

Why a Perfectly Competitive Firm Equates Marginal Cost and Price

For a price-taking firm:

$$TR = P \cdot Q, \quad AR = \frac{TR}{Q} = P, \quad MR = \frac{d(TR)}{dQ} = P.$$

The firm maximizes profit (π) by choosing Q such that:

$$\pi(Q) = TR(Q) - TC(Q).$$

Differentiating with respect to Q gives the first-order condition for profit maximization:

$$\frac{d\pi}{dQ} = \frac{dTR}{dQ} - \frac{dTC}{dQ} = MR - MC = 0 \implies MR = MC.$$

Since $MR = P$ for a competitive firm:

$$P = MC.$$

Profits and Losses: Entry and Exit Dynamics

In the short run, firms can make profits or losses:

- **Profits** ($P > ATC$): New firms enter the market, increasing supply and lowering price until profits are eliminated.
- **Losses** ($P < ATC$): Existing firms exit the market, reducing supply and raising price until losses are eliminated.
- **Break-even** ($P = ATC$): Firms earn normal profits (zero economic profit), and there is no incentive for entry or exit.

In the short run, the firm produces only if $P \geq AVC$. The shut-down condition is:

$$P < AVC \implies \text{Firm exits the market.}$$

Drawing the Industry Supply Curve

Short-Run Industry Supply Curve

The short-run supply curve of an individual firm is its marginal cost (MC) curve above the average variable cost (AVC) curve. The industry supply curve is the horizontal summation of all individual firms' supply curves:

$$Q_s = \sum_{i=1}^{N} Q_{s_i},$$

where Q_{s_i} is the supply of the i-th firm and N is the number of firms.

Long-Run Industry Supply Curve

In the long run:

- Firms enter or exit the market, ensuring zero economic profit ($P = ATC$).
- The long-run supply curve is horizontal if input prices remain constant as the industry expands.
- If input prices increase with industry expansion, the long-run supply curve slopes upward.

Comparative Static Analysis of a Competitive Industry

Effect of a Shift in Market Demand

An increase in demand shifts the market demand curve outward:

1. In the short run, the price rises, increasing firms' profits.
2. In the long run, new firms enter, increasing supply and driving the price back to the break-even level ($P = ATC$).

Effect of a Change in Costs

An increase in costs (e.g., higher input prices) shifts the cost curves upward:

1. Firms with $P < AVC$ shut down in the short run, reducing market supply.
2. In the long run, remaining firms adjust their scale of production, and the market reaches a new equilibrium with higher prices.

Mathematical Formulas and Conditions

Revenue and Cost Relationships

$$TR = P \cdot Q, \quad AR = \frac{TR}{Q}, \quad MR = \frac{dTR}{dQ}.$$

$$TC = FC + VC, \quad ATC = \frac{TC}{Q}, \quad MC = \frac{dTC}{dQ}.$$

Profit Maximization

$$MR = MC, \quad P = MC \text{ (for a competitive firm)}.$$

Short-Run Supply Decision

$$\text{Produce if } P \geq AVC, \quad \text{Shut down if } P < AVC.$$

Long-Run Equilibrium

$$P = MC = ATC.$$

Graphical Analysis

Firm-Level Short-Run Equilibrium

$$\text{Profit} = (P - ATC) \cdot Q, \quad \text{Loss} = (ATC - P) \cdot Q.$$

Graphically, profits and losses are represented by the area between price and the ATC curve at the equilibrium quantity.

Market Adjustment to Demand Shifts

Graphs illustrating:

- Initial equilibrium (P_0, Q_0).
- Short-run price increase (P_1, Q_1) due to increased demand.
- Long-run price stabilization (P_0, Q_2) after entry restores equilibrium.

Efficiency in Perfect Competition

Perfect competition leads to:

- **Allocative efficiency:** $P = MC$, ensuring resources are distributed optimally.
- **Productive efficiency:** Firms produce at the minimum point of the ATC curve.

Block 5: The Firm

Economic vs Accounting Definitions of Cost

- **Accounting Cost:** Explicit costs recorded in the firm's financial statements, such as wages, rent, and materials.
- **Economic Cost:** Includes both explicit costs and implicit costs (opportunity costs of using resources in their next best alternative).

For example, the opportunity cost of an entrepreneur's time or capital invested in the firm is part of economic cost but not accounting cost.

Relationship Between Revenue, Cost, and Profit

Profit (π) is the difference between total revenue (TR) and total cost (TC):

$$\pi = TR - TC,$$

where:

$$TR = P \cdot Q, \quad TC = FC + VC.$$

The Production Function

The production function represents the relationship between inputs (e.g., labor L and capital K) and output Q:

$$Q = f(L, K).$$

- **Short Run:** At least one input (e.g., K) is fixed.
- **Long Run:** All inputs are variable.

Point of Diminishing Marginal Returns

- **Marginal Product (MP):** The additional output produced by an additional unit of input.
$$MP_L = \frac{\Delta Q}{\Delta L}.$$
- **Diminishing Marginal Returns:** Occurs when MP_L begins to decrease as more units of L are added while K remains fixed.

Choice of Production Technique and Input Price

Firms minimize costs by choosing the optimal combination of inputs based on input prices:

$$\text{Minimize } C = wL + rK, \quad \text{subject to } Q = f(L, K),$$

where w is the wage rate and r is the rental rate of capital.

Isoquants and Isocost Curves

- **Isoquants:** Combinations of L and K that produce the same level of output (Q_0).
- **Isocost Lines:** Combinations of L and K that have the same total cost (C):
$$C = wL + rK \implies K = \frac{C}{r} - \frac{w}{r}L.$$
- **Cost Minimization:** The optimal combination of L and K occurs where the slope of the isoquant equals the slope of the isocost line:
$$\frac{MPL}{MPK} = \frac{w}{r}.$$

Marginal Cost and Marginal Revenue

- **Marginal Cost (MC):** The additional cost of producing one more unit of output:
$$MC = \frac{\Delta TC}{\Delta Q}.$$
- **Marginal Revenue (MR):** The additional revenue from selling one more unit of output:
$$MR = \frac{\Delta TR}{\Delta Q}.$$

Profit-Maximizing Level of Output

The profit-maximizing output (Q^*) occurs where:

$$MR = MC.$$

If the demand curve is $P = f(Q)$, then:

$$TR = P \cdot Q, \quad MR = \frac{d(TR)}{dQ}.$$

Fixed and Variable Factors in the Short Run

- **Fixed Factors:** Inputs that do not change with output (e.g., rent, machinery).
- **Variable Factors:** Inputs that change with output (e.g., labor, materials).

Cost Analysis in the Short Run and Long Run

Short Run:

$$TC = FC + VC, \quad ATC = \frac{TC}{Q}, \quad AVC = \frac{VC}{Q}.$$

$$MC = \frac{dTC}{dQ}.$$

The **law of diminishing returns** causes the MC, AVC, and ATC curves to be U-shaped.

Long Run:

$$LTC = f(Q), \quad LAC = \frac{LTC}{Q}, \quad LMC = \frac{dLTC}{dQ}.$$

All inputs are variable, and firms can choose the optimal scale of production.

Returns to Scale and Average Cost Curves

- **Increasing Returns to Scale:** Doubling inputs more than doubles output (LAC decreases).
- **Constant Returns to Scale:** Doubling inputs doubles output (LAC is constant).
- **Decreasing Returns to Scale:** Doubling inputs less than doubles output (LAC increases).

Output Choice in the Short Run and Long Run

- **Short Run:** Produce where $P = MC$, provided $P \geq AVC$.
- **Long Run:** Produce where $P = MC = LAC$, ensuring normal profits.

Relationship Between Short-Run and Long-Run Costs

- **Short-Run Cost Curves:** Based on a fixed level of input (e.g., capital).
- **Long-Run Cost Curves:** Envelop all short-run cost curves, representing the lowest cost for any output level.

Graphical Representation of Cost Curves

- **Short-Run Curves:** MC intersects AVC and ATC at their minimum points.
- **Long-Run Curves:** LMC intersects LAC at its minimum point.

Block 4: Consumer Choice

Utility and Consumer Tastes

Utility is the satisfaction or pleasure that a consumer derives from consuming goods and services. Consumer tastes reflect preferences and are represented by a utility function, $U(x, y)$, where x and y are quantities of two goods.

Diminishing Marginal Utility

Marginal utility (MU) is the additional utility gained from consuming one more unit of a good:

$$MU_x = \frac{\Delta U}{\Delta x}, \quad MU_y = \frac{\Delta U}{\Delta y}.$$

Diminishing marginal utility states that as a consumer consumes more of a good, the additional utility derived from each additional unit decreases.

Diminishing Marginal Rate of Substitution (MRS)

The Marginal Rate of Substitution (MRS) is the rate at which a consumer is willing to give up one good for another while maintaining the same level of utility. It is calculated as:

$$MRS = -\frac{MU_x}{MU_y}.$$

Diminishing MRS occurs because as the consumer substitutes one good for another, the relative utility of the good being added decreases.

Indifference Curves Represent Tastes

Indifference curves represent combinations of two goods that provide the consumer with the same level of utility. Properties of indifference curves:

- Downward sloping (trade-offs between goods).

- Convex to the origin (reflecting diminishing MRS).
- Do not intersect (consistency in preferences).

Budget Line

The budget line represents all combinations of goods a consumer can afford given income (M) and prices (P_x, P_y):

$$P_x \cdot x + P_y \cdot y = M.$$

The slope of the budget line reflects the opportunity cost of one good in terms of the other:

$$\text{Slope} = -\frac{P_x}{P_y}.$$

Indifference Curves and Budget Constraints

A consumer maximizes utility by choosing the point where an indifference curve is tangent to the budget line:

$$\text{At optimal choice: } MRS = -\frac{P_x}{P_y}.$$

This means that the rate at which the consumer is willing to substitute one good for another equals the rate at which the market allows substitution.

Effects of Changes in Income

An increase in income shifts the budget line outward, allowing the consumer to achieve a higher indifference curve. The change in quantity demanded depends on whether the good is:

- **Normal Good:** Quantity demanded increases with income.
- **Inferior Good:** Quantity demanded decreases with income.

Effects of a Price Change

A price change pivots the budget line. The impact on quantity demanded can be decomposed into:

- **Substitution Effect:** Change due to relative price change, holding utility constant.
- **Income Effect:** Change due to a change in purchasing power.

Income and Substitution Effects

For a normal good, both effects lead to an increase in quantity demanded when the price falls. For an inferior good, the income effect may partially offset the substitution effect.

Market Demand Curve from Individual Demand Curves

The market demand curve is the horizontal summation of individual demand curves:

$$Q^D_{\text{market}} = \sum_{i=1}^{n} Q^D_i.$$