

# H2 Economics (9570)

## Theme 2.1: Price Mechanism and its Applications — Lecture Notes

A-Level 2027 Syllabus

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## The Price Mechanism

### What is the Price Mechanism?

#### Definition Price Mechanism

The **price mechanism** (or market mechanism) is the system through which the forces of demand and supply interact to determine prices and allocate scarce resources. In a free market, prices act as signals that coordinate the decisions of consumers and producers without central planning.

The price mechanism answers the **three fundamental economic questions**:

- **What to produce?** — Goods that command high prices relative to cost are profitable, so firms produce them.
- **How to produce?** — Firms choose the least-cost method of production, since this maximises profit.
- **For whom to produce?** — Goods go to those willing and able to pay the market price.

### The Three Functions in Detail

#### 1. Signalling Function

##### Definition Signalling

Prices convey information about relative scarcity. A rising price signals that the good is relatively scarcer or more desired; a falling price signals abundance or reduced demand.

**Mechanism:** Prices are the language of the market. Without any central coordinator, price movements communicate information across the entire economy. If consumers want more of a good, their increased willingness to pay drives the price up. This price rise signals to producers: “produce more of this, it is now more valuable.”

##### Example Signalling: Property Market Cooling Measures

In 2023, Singapore introduced higher Additional Buyer’s Stamp Duty (ABSD) rates. This reduced demand from investors and foreign buyers, causing property transaction volumes to fall. The fall in transaction volume signalled to developers that demand had softened, leading them to adjust launch prices and project timelines.

#### 2. Incentive Function

##### Definition Incentive

Prices create incentives for economic agents to alter their behaviour. Higher prices incentivise producers to increase output (profit motive). Lower prices incentivise consumers to buy more.

**Mechanism:** When prices rise, firms see higher potential profits. This incentivises them to:

- Increase production (hire more workers, run factories longer)
- Enter the market (new firms attracted by profit opportunity)
- Invest in capacity expansion

When prices fall, consumers are incentivised to buy more. The incentive function also works in reverse: falling prices incentivise firms to cut production.

### Example Incentive: ERP and Driving Behaviour

Singapore's Electronic Road Pricing (ERP) system charges drivers when entering congested areas. Higher ERP rates during peak hours incentivise drivers to:

- Travel at off-peak times
- Use alternative routes
- Switch to public transport
- Carpool

The price signal directly changes behaviour, reducing congestion without needing a quota or ban.

### 3. Rationing Function

#### Definition Rationing

When a good is scarce, the price mechanism rations it to those who are willing and able to pay the highest price. Higher prices reduce quantity demanded to match available supply, eliminating the need for non-price rationing (queues, lotteries, government allocation).

**Mechanism:** Suppose a supply shock (e.g., crop failure) reduces output. Without price adjustment, there would be empty shelves and queues. With price adjustment, the price rises, and consumers respond by:

- Reducing consumption
- Switching to substitutes
- Only those who value the good most continue buying at the higher price

The market “clears” without government intervention.

#### Singapore Case Study COE and Rationing

The COE system is a prime example of rationing, but with a twist: the government controls *quantity*, and the market determines *price*. With a fixed annual quota of COEs, the price adjusts to ration the limited number of certificates among Singaporean car buyers. In May 2023, Cat A COE prices hit SGD \$106,000 — effectively rationing car ownership to only the wealthiest households and those most willing to pay.

#### Warning Exam Tip: The Three Functions Together

An excellent answer explicitly shows **how all three functions work together** in a real scenario:

1. A supply shock occurs (e.g., oil supply cut)
2. Price rises → **signals** scarcity
3. Higher price **incentivises** producers to increase oil output and consumers to conserve
4. Higher price **ration**s the limited oil among highest-value users

## The Price Mechanism in Different Economic Systems

Feature	Free Market	Command Economy	Mixed Economy
Who decides?	Consumers & firms via prices	Central government	Both market & government
Price role	Rationing, signalling, incentive	Administered by planners	Market prices with interventions
Example	Hong Kong (limited govt)	North Korea	Singapore (strong govt + free markets)
Efficiency	High (allocative efficiency)	Low (bureaucratic, misallocation)	Variable
Equity	Low (income determines access)	High (theoretically)	Moderate (targeted transfers)

**Singapore is a mixed economy:** We rely heavily on the price mechanism for resource allocation (free trade, market-determined wages, market-priced housing), but the government actively intervenes to correct what it sees as market failures and to achieve equity objectives (HDB subsidies, healthcare subsidies, CPF system, COE quotas, education funding).

## Demand Analysis

### Individual Demand

#### Definition Individual Demand

The quantity of a good a single consumer is **willing and able** to purchase at each price over a given period, *ceteris paribus*. Two conditions must hold: **willingness** (desire for the good) and **ability** (purchasing power).

### The Law of Demand

#### Definition Law of Demand

There is an **inverse relationship** between the price of a good and the quantity demanded, *ceteris paribus*. As price falls, quantity demanded rises; as price rises, quantity demanded falls.

#### Why? Three complementary explanations:

1. **Substitution Effect:** When the price of Good X falls, it becomes *relatively* cheaper compared to its substitutes. Consumers substitute away from the now-relatively-more-expensive substitutes toward Good X. Example: If Grab fares drop, consumers switch from taking MRT to taking Grab.
2. **Income Effect:** A fall in price increases consumers' *real income* — they can buy the same quantity and still have money left over. This extra purchasing power allows them to buy more of the good (assuming it's a normal good). Example: When rice prices fall, households can afford to buy more rice *and* still have money for other goods.
3. **Diminishing Marginal Utility:** Each additional unit of a good consumed yields less additional satisfaction (marginal utility). Consumers will only buy more units if the price falls sufficiently to compensate for the lower marginal utility.

#### Exam Tip Which Reason to Use in Exams

- For simple explain questions: substitution + income effects are sufficient
- For utility-based questions: use diminishing marginal utility (more theoretical, higher marks)
- For questions involving Giffen/Veblen goods (not in syllabus but shows sophistication): note that the law of demand has exceptions for inferior goods in extreme poverty situations

### Market Demand

#### Definition Market Demand

Market demand is the **horizontal summation** of all individual demand curves. At each price, we add up the quantities demanded by every consumer in the market.

## Derivation Numerical Example: Market Demand from Two Consumers

Price (\$)	Consumer A (Qd)	Consumer B (Qd)	Market Qd
10	0	0	0
8	1	0	1
6	2	1	3
4	3	2	5
2	4	3	7

At each price, market Qd = Consumer A's Qd + Consumer B's Qd. The market demand curve reflects the aggregate behaviour of all consumers.

## Critical Distinction: Movement vs Shift

## Warning Most Common Error in A-Level Economics Exam

This distinction is worth more marks than any other single concept. Learn it perfectly.

- **Change in Quantity Demanded:** A movement **along** the demand curve. Caused **only** by a change in the good's **own price**. The ceteris paribus assumption holds — all other factors remain unchanged.
  - Price falls → extension (increase) in Qd
  - Price rises → contraction (decrease) in Qd
- **Change in Demand:** A **shift** of the entire demand curve. Caused by a change in any **non-price determinant** of demand. At every price, consumers now want more (right shift) or less (left shift).

## Example of the error:

- **Wrong:** “When the price of cars increases, demand for cars decreases.”
- **Right:** “When the price of cars increases, *quantity demanded* for cars decreases — a contraction of demand shown as a movement along the demand curve. A *decrease in demand* would be a leftward shift caused by factors like a fall in income or a rise in the price of a complement like petrol.”

## Determinants of Demand (Non-Price Factors)

Each non-price determinant shifts the demand curve. For exams, you must be able to explain **why** a change in each factor shifts demand.

## 1. Income

- **Normal goods:**  $Y \uparrow \Rightarrow D \uparrow$  (right shift). Examples: restaurant meals, branded goods, car ownership.
- **Inferior goods:**  $Y \uparrow \Rightarrow D \downarrow$  (left shift). Examples: instant noodles, public transport, budget supermarket brands.

### Singapore Case Study Income and Car Demand

Singapore’s rising median income (from \$5,000 in 2018 to over \$6,500 by 2023) has increased demand for cars as a normal good — despite the high COE prices. This is why COE prices have remained elevated: increased purchasing power (income effect) means more households can afford cars at current prices, sustaining demand even at high price levels.

## 2. Prices of Related Goods

- **Substitutes:** Two goods are substitutes if they satisfy the same need.
  - $P_{Sub} \uparrow \Rightarrow D_{Good} \uparrow$  (consumers switch to the good).
  - Examples: Coke  $\leftrightarrow$  Pepsi; MRT  $\leftrightarrow$  Bus; Grab  $\leftrightarrow$  Taxi
- **Complements:** Two goods are complements if they are consumed together.
  - $P_{Comp} \uparrow \Rightarrow D_{Good} \downarrow$  (consumers buy less of the bundle).
  - Examples: Cars  $\leftrightarrow$  Petrol; Phones  $\leftrightarrow$  Phone cases; Printers  $\leftrightarrow$  Ink cartridges

### Singapore Case Study Complements: COE and Car Demand

The COE price is essentially part of the “cost of car ownership” bundle. When COE prices surged from \$40,000 (2020) to over \$100,000 (2023), the total cost of buying a car rose dramatically. This reduced demand for cars (complement effect — COE and cars are consumed together). Some buyers switched to used cars (substitute) or delayed their purchase entirely.

## 3. Tastes and Preferences

Changes in consumer preferences driven by advertising, trends, health awareness, cultural shifts, seasons, and social influence.

### Singapore Case Study Tastes: Bubble Tea and Health Trends

Bubble tea demand in Singapore exploded 2018–2021, driven by social media trends and new store openings (shift right). However, growing health awareness (Nutri-Grade labelling, diabetes concerns) from 2022 has shifted demand left as health-conscious consumers reduce consumption. The Nutri-Grade labelling scheme itself changed preferences by making sugar content salient.

## 4. Expectations

- Expected **future price increase**  $\Rightarrow$  current demand  $\uparrow$  (buy now to avoid higher price)
- Expected **future price decrease**  $\Rightarrow$  current demand  $\downarrow$  (delay purchase)
- Expected **future income increase**  $\Rightarrow$  current demand  $\uparrow$  (optimism)

### Example Expectations: COE Announcements

Before each COE bidding exercise, market expectations about the quota affect current demand. If the government announces a sharp reduction in future COE supply, current demand rises as buyers rush to secure a COE before prices climb further. This self-fulfilling dynamic amplifies COE price volatility.

## 5. Population and Demographics

- Population size  $\uparrow \Rightarrow$  market demand  $\uparrow$  (more consumers)
- Age structure changes affect demand for different goods (ageing population  $\Rightarrow$  healthcare demand  $\uparrow$ )

### Singapore Case Study Demographics and Healthcare Demand

Singapore's rapidly ageing population (1 in 4 citizens will be 65+ by 2030) is structurally shifting demand for healthcare services, retirement housing, and eldercare — while demand for education and childcare grows more slowly. This is a long-term, predictable demand shift.

## 6. Government Policies

Policies can directly affect demand: taxes (GST increase reduces purchasing power), regulations (ban on certain goods), information campaigns (anti-drug, anti-smoking).

### Example Government Policy: Sugar Tax and Nutri-Grade

Singapore's Nutri-Grade labelling (mandatory since end 2022 for packaged drinks) and impending advertising ban on high-sugar drinks are designed to shift consumer preferences away from sugary beverages — a policy-driven leftward shift in demand. Combined with the sugar-sweetened beverage tax (under consideration), these policies aim to address rising diabetes rates.

## Supply Analysis

### Individual Supply

#### Definition Supply

The quantity of a good that a producer is **willing and able** to offer for sale at each price over a given period, *ceteris paribus*.

### The Law of Supply

#### Definition Law of Supply

There is a **direct (positive) relationship** between price and quantity supplied, *ceteris paribus*. As price rises, quantity supplied rises; as price falls, quantity supplied falls.

**Why? Two reasons:**

1. **Profit Motive:** A higher price means higher revenue per unit, making production more profitable. Firms respond by increasing output.
2. **Increasing Marginal Cost:** In the short run, as output increases, firms encounter diminishing returns — each additional unit costs more to produce. Firms will only produce these costlier units if the price compensates for the higher marginal cost.

### Market Supply

#### Definition Market Supply

Market supply is the **horizontal summation** of all individual firms' supply curves. At each price, we add up the quantities supplied by every producer.

#### Derivation Numerical Example: Market Supply

Price (\$)	Firm X (Qs)	Firm Y (Qs)	Firm Z (Qs)	Market Qs
2	10	5	0	15
4	20	10	5	35
6	30	15	10	55
8	40	20	15	75

### Movement vs Shift (Supply)

#### Warning Same Trap, Different Curve

- **Change in Quantity Supplied:** Movement **along** the supply curve, caused **only** by a change in the good's own price.
- **Change in Supply:** A **shift** of the entire supply curve, caused by a change in any non-price determinant.

### Determinants of Supply (Non-Price Factors)

#### 1. Cost of Production

- Input prices (wages, raw materials, energy, rent)  $\uparrow \Rightarrow$  cost  $\uparrow \Rightarrow$  supply  $\downarrow$  (left shift)

- Technology improves  $\Rightarrow$  cost  $\downarrow$   $\Rightarrow$  supply  $\uparrow$  (right shift)

### Singapore Case Study Cost of Production: Foreign Worker Levy

Singapore's foreign worker levy is a per-worker tax that effectively raises the cost of labour for firms. When the government increases the levy (as planned for 2025, to reduce dependency on foreign workers), the cost of production rises, shifting the supply curve leftward for labour-intensive sectors (construction, F&B, shipyard). Firms respond by:

- Raising prices to pass on costs
- Investing in automation to reduce reliance on foreign workers
- Reducing output where automation is not feasible

## 2. Prices of Related Goods in Production

- **Substitutes in production:** Goods competing for the same resources. If the price of Good B rises, firms shift resources to produce B, reducing supply of Good A (left shift for A).
  - Example: A farmer growing durians and mangosteens. If durian prices rise, the farmer allocates more land to durians, reducing mangosteen supply.
- **Complements in production (joint supply):** Goods produced together. If the price of Good A rises, supply of Good B rises automatically.
  - Example: Beef and leather. Higher beef demand  $\Rightarrow$  more cattle slaughtered  $\Rightarrow$  more leather supplied (right shift for leather) even if leather demand hasn't changed.

## 3. Government Policies

- **Taxes:** Increase costs  $\Rightarrow$  supply  $\downarrow$  (left shift)
- **Subsidies:** Decrease costs  $\Rightarrow$  supply  $\uparrow$  (right shift)
- **Regulations:** Safety, environmental, licensing requirements can restrict supply

## 4. Expectations

Expected future prices affect current supply decisions. If farmers expect higher prices next season, they may store output to sell later (current supply  $\downarrow$ ). If producers expect lower future prices, they may sell as much as possible now (current supply  $\uparrow$ ).

## 5. Number of Firms

More firms entering the market  $\Rightarrow$  market supply  $\uparrow$  (right shift). Fewer firms (due to exits, industry consolidation)  $\Rightarrow$  supply  $\downarrow$  (left shift).

## 6. External Shocks

Natural disasters, weather, geopolitical events, pandemics — these are sudden, unpredictable supply shocks.

**Singapore Case Study External Shocks: COVID-19 and Supply Chains**

COVID-19 caused massive supply disruptions for Singapore:

- Global semiconductor shortage → reduced supply of cars, electronics
- Disrupted aviation → reduced supply of airfreight capacity, inflating shipping costs
- Lockdowns in China (2022) → reduced supply of intermediate goods for Singapore's manufacturing sector

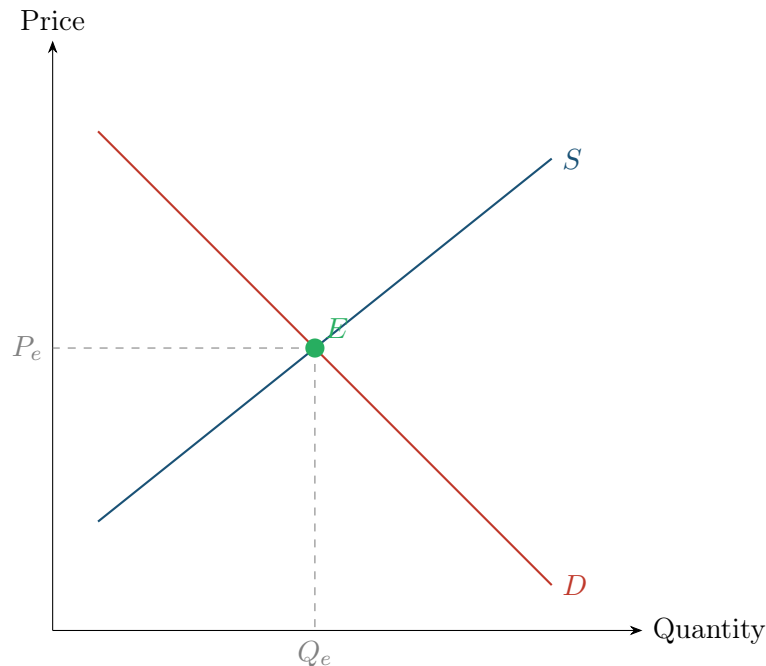
These supply shocks shifted supply curves leftward across multiple sectors simultaneously, contributing to cost-push inflation.

## Market Equilibrium & Disequilibrium

### Equilibrium

#### Definition Market Equilibrium

Occurs when  $Q_d = Q_s$  at a given price. The equilibrium price ( $P_e$ ) clears the market — no shortage, no surplus.



### Disequilibrium and the Adjustment Process

#### Surplus (Excess Supply)

#### Definition Surplus

When  $Q_s > Q_d$  at the current price. Occurs when price is **above** equilibrium.

#### Adjustment process:

1. Producers cannot sell all their output → inventories build up
2. Firms cut prices to clear excess stock
3. As price falls,  $Q_d$  expands (along D) and  $Q_s$  contracts (along S)
4. Process continues until  $Q_d = Q_s$  at the new equilibrium

#### Example Surplus: Tech Product Launch Failure

When a new smartphone model fails to catch consumer interest, retailers are left with unsold inventory (surplus). They respond by slashing prices (e.g., 20–40% discounts within months of launch). The price cut attracts more buyers (movement down the demand curve) and some firms stop producing (movement down the supply curve), until the market clears.

## Shortage (Excess Demand)

### Definition Shortage

When  $Q_d > Q_s$  at the current price. Occurs when price is **below** equilibrium.

#### Adjustment process:

1. Consumers compete for limited supply → queues, waiting lists
2. Firms perceive unmet demand and raise prices
3. As price rises,  $Q_d$  contracts (along D) and  $Q_s$  expands (along S)
4. Process continues until  $Q_d = Q_s$  at the new equilibrium

### Singapore Case Study Shortage: COE Quota Tightening

When Singapore announced a smaller COE quota for 2023–2025, the supply of new COEs fell below the quantity demanded at existing COE prices. This created a shortage. The bidding process (a proxy for price adjustment) pushed COE prices sharply higher. As prices rose:

- Some buyers were priced out ( $Q_d$  contracted along the demand curve)
- Some potential sellers brought forward their car replacement ( $Q_s$  expanded)
- A new equilibrium was reached at a higher COE price

## Changes in Equilibrium: Shifts in D and/or S

### Single Shift Analysis

Scenario	Price	Quantity
Demand ↑ (right shift)	↑	↑
Demand ↓ (left shift)	↓	↓
Supply ↑ (right shift)	↓	↑
Supply ↓ (left shift)	↑	↓

### Simultaneous Shifts

When both curves shift, one variable becomes **ambiguous** (depends on relative magnitudes):

Scenario	Price	Quantity
D ↑ + S ↑	Ambiguous (↑ if D shift dominates; ↓ if S shift dominates)	↑ (unambiguously)
D ↑ + S ↓	↑ (unambiguously)	Ambiguous (↑ if D dominates; ↓ if S dominates)
D ↓ + S ↑	↓ (unambiguously)	Ambiguous (↑ if S dominates; ↓ if D dominates)
D ↓ + S ↓	Ambiguous (↑ if S dominates; ↓ if D dominates)	↓ (unambiguously)

**Exam Tip Simultaneous Shifts in Exams**

When asked about simultaneous shifts, explain the ambiguity clearly:

- State what happens to the unambiguous variable (P or Q)
- For the ambiguous variable, say “the net effect on [X] depends on the relative magnitude of the demand shift vs the supply shift”
- Offer both possibilities and state which is more likely given context

**Singapore Case Study Simultaneous Shift: Post-COVID Property Market**

Singapore’s private property market post-COVID saw **both D and S shifting**:

- D ↑ (right): Low interest rates, WFH driving demand for space, limited travel spending redirected to housing, wealth effects from rising asset prices
- S ↓ (left): Construction delays from COVID (labour shortages, supply chain disruptions), land supply constraints
- Net effect: P ↑↑ (unambiguous, both shifts push price up), Q ambiguous

This is why private property prices rose 8–12% annually in 2021–2023 despite government cooling measures.

## Consumer and Producer Surplus

### Consumer Surplus

#### Definition Consumer Surplus

The difference between the **maximum price** a consumer is willing to pay (their reservation price, reflecting marginal utility) and the **actual market price** they pay.

**Graphically:** The triangular area below the demand curve and above the equilibrium price, up to the equilibrium quantity.

**Intuition:** Every consumer willing to pay \$8 for a good buys it for \$5. Their surplus is \$3 per unit. Add up this surplus across all units purchased to get total consumer surplus.

#### Derivation Numerical CS Example

Suppose the demand curve is  $P = 10 - Q$  and the market price is \$4.

- Consumer A ( $Q=1$ ): willing to pay \$10, pays \$4 → CS = \$6
- Consumer B ( $Q=2$ ): willing to pay \$8, pays \$4 → CS = \$4
- Consumer C ( $Q=3$ ): willing to pay \$6, pays \$4 → CS = \$2
- Consumer D ( $Q=4$ ): willing to pay \$4, pays \$4 → CS = \$0

Total CS = \$6 + \$4 + \$2 + \$0 = \$12. Graphically, this is the triangle with base 4 and height 6:  $\frac{1}{2} \times 4 \times 6 = 12$ .

### Producer Surplus

#### Definition Producer Surplus

The difference between the **actual market price** a producer receives and the **minimum price** they are willing to accept (their marginal cost).

**Graphically:** The triangular area above the supply curve and below the equilibrium price, up to the equilibrium quantity.

**Intuition:** A producer willing to sell at \$2 per unit sells at \$5. Their surplus is \$3 per unit. This surplus represents the profit (above variable cost) earned on each unit.

### Total Surplus and Allocative Efficiency

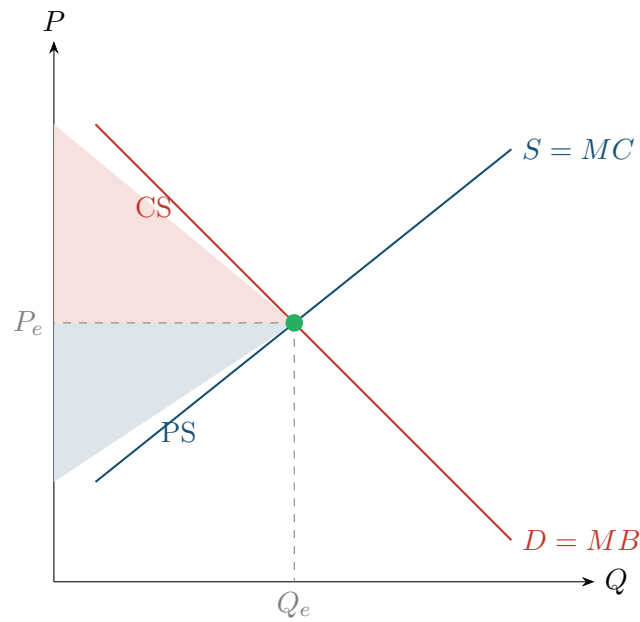
#### Definition Total (Social) Surplus

Total Surplus = Consumer Surplus + Producer Surplus

#### Definition Allocative Efficiency

At the competitive market equilibrium, total surplus is **maximised**. This is because:

- Every unit where the consumer's willingness to pay exceeds the producer's marginal cost is produced and consumed
- No unit is produced where the cost exceeds the value consumers place on it
- This is the condition for allocative efficiency:  $MB = MC$  at the margin



### How Changes Affect CS and PS

- **Price decrease (e.g., supply increase):**
  - CS increases: existing consumers pay less (rectangular gain) + new consumers enter (triangular gain)
  - PS decreases: existing producers receive less + some exit
- **Price increase (e.g., demand increase):**
  - CS decreases: existing consumers pay more + some exit
  - PS increases: existing producers receive more + new firms enter

#### Exam Tip CS/PS on Diagrams

When a policy changes  $P$  and  $Q$ , always analyse the impact on CS and PS:

1. Identify the old CS/PS area
2. Identify the new CS/PS area after the change
3. The difference is the gain or loss
4. The loss not captured by anyone is **deadweight loss** (DWL)

## Elasticities

### Price Elasticity of Demand (PED)

#### Definition Price Elasticity of Demand

$$PED = \frac{\% \Delta \text{Quantity Demanded}}{\% \Delta \text{Price}} = \frac{\Delta Q}{Q} \div \frac{\Delta P}{P}$$

PED measures the **responsiveness** of quantity demanded to a change in the good's own price. By the law of demand,  $\% \Delta Q_d$  and  $\% \Delta P$  move in opposite directions, so PED is always **negative**. We conventionally refer to the **absolute value**.

#### Interpreting PED Values

Value	Term	Meaning
$ PED  = 0$	Perfectly inelastic	Qd doesn't change when price changes (vertical D curve)
$0 <  PED  < 1$	Inelastic	Qd changes by a smaller % than price
$ PED  = 1$	Unit elastic	Qd changes by exactly the same % as price
$1 <  PED  < \infty$	Elastic	Qd changes by a larger % than price
$ PED  = \infty$	Perfectly elastic	Any price increase reduces Qd to zero (horizontal D curve)

#### Example PED in Practice: Singapore Examples

- **Inelastic:** Petrol ( $|PED| \approx 0.3$ ) — drivers must fuel their cars regardless of price. Cigarettes ( $|PED| \approx 0.4$ ) — addiction creates low responsiveness. Electricity ( $|PED| \approx 0.2$ ) — essential, few substitutes.
- **Elastic:** Air travel ( $|PED| \approx 2.5$ ) — many airlines compete, consumers can delay trips. Restaurant meals ( $|PED| \approx 1.5$ ) — easily substituted with home cooking. Branded clothing ( $|PED| \approx 2.0$ ) — many alternatives.

#### Determinants of PED

1. **Availability of substitutes (most important):** More substitutes  $\Rightarrow$  more elastic. Salt has few substitutes (highly inelastic). A specific brand of bottled water has many substitutes (highly elastic).
2. **Necessity vs luxury:** Necessities (food, medicine, housing) are inelastic; luxuries (designer goods, holidays) are elastic.
3. **Proportion of income:** Goods that take a small share of income (salt, matchsticks) are inelastic. Goods that take a large share (cars, houses) are more elastic — consumers care more about price changes.
4. **Time horizon:** Demand is more elastic in the long run. When petrol prices rise, drivers initially continue driving (inelastic). Over time, they switch to smaller cars, public transport, or electric vehicles (more elastic). This is because consumers need time to adjust behaviour and find substitutes.
5. **Breadth of definition:** Narrowly defined goods have more elastic demand. “Coca-Cola” has many substitutes  $\Rightarrow$  elastic. “Soft drinks” has fewer substitutes  $\Rightarrow$  less elastic. “Beverages” has almost no substitutes  $\Rightarrow$  inelastic.

**Exam Tip PED Determinants in Essays**

When asked why a good has a particular PED, always state 2–3 determinants in order of importance. The most important is usually **availability of substitutes**. This is also the primary reason governments target addictive goods (cigarettes, alcohol) with high taxes — because their inelastic demand means the tax raises revenue effectively.

**PED and Total Revenue****Derivation The Critical PED-TR Relationship**

Total Revenue (TR) = Price  $\times$  Quantity. The effect of a price change on TR depends on PED:

- **Elastic demand** ( $|PED| > 1$ ):
  - Price  $\uparrow \Rightarrow$  Qd falls **proportionally more**  $\Rightarrow$  TR  $\downarrow$
  - Price  $\downarrow \Rightarrow$  Qd rises **proportionally more**  $\Rightarrow$  TR  $\uparrow$
- **Inelastic demand** ( $|PED| < 1$ ):
  - Price  $\uparrow \Rightarrow$  Qd falls **proportionally less**  $\Rightarrow$  TR  $\uparrow$
  - Price  $\downarrow \Rightarrow$  Qd rises **proportionally less**  $\Rightarrow$  TR  $\downarrow$
- **Unit elastic** ( $|PED| = 1$ ): TR is unchanged by price changes.

**Intuition:** If a firm sells a good with inelastic demand (e.g., petrol), raising the price will increase total revenue because the drop in quantity sold is smaller than the price increase. This is why firms want products with inelastic demand, and why governments tax inelastic goods heavily — the lost quantity is small, so revenue is high.

**Singapore Case Study PED and COE Pricing**

The Singapore government sets the COE quota (quantity), and the market determines the price. Because car demand is relatively inelastic in the short run (committed car buyers still need COEs), a fixed reduction in quota leads to a disproportionately large price increase. This means total revenue from COEs (paid to the government) increases when supply is cut — a direct application of the PED-TR relationship.

**PED along a Linear Demand Curve****Warning PED  $\neq$  Slope**

A common mistake. The slope of a linear demand curve is constant ( $\Delta P/\Delta Q$ ), but PED varies at each point because it uses **percentage changes**:

$$PED = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

The first term ( $\Delta Q/\Delta P = 1/\text{slope}$ ) is constant. But the ratio  $P/Q$  varies: at high prices,  $P/Q$  is large  $\Rightarrow$  elastic. At low prices,  $P/Q$  is small  $\Rightarrow$  inelastic.

- At the **midpoint** of a linear demand curve:  $|PED| = 1$  (unit elastic)
- Above the midpoint:  $|PED| > 1$  (elastic)
- Below the midpoint:  $|PED| < 1$  (inelastic)

## Income Elasticity of Demand (YED)

### Definition Income Elasticity of Demand

$$YED = \frac{\% \Delta \text{Quantity Demanded}}{\% \Delta \text{Income}} = \frac{\Delta Q}{Q} \div \frac{\Delta Y}{Y}$$

Measures how responsive demand is to changes in consumer income.

### Interpreting YED

YED Value	Type of Good	Example
$YED > 1$	Luxury / superior	International travel, fine dining, luxury cars
$0 < YED < 1$	Normal necessity	Bread, basic clothing, public transport
$YED < 0$	Inferior good	Instant noodles, budget supermarket brands

### Why YED Matters:

- During economic growth ( $Y \uparrow$ ): demand for luxury goods grows fastest (high YED producers expand capacity; inferior good producers contract)
- During recession ( $Y \downarrow$ ): luxury good producers suffer most (revenue falls sharply); inferior goods sellers may thrive
- **Singapore context:** Rising incomes mean demand shifts from inferior goods to normal goods, and from necessities to luxuries. Hawker centres (necessity) see steady demand; fine dining (luxury) grows faster than GDP growth

### Example YED in a Recession

During a recession (COVID-19, 2020), Singapore's GDP contracted 4.1%. Luxury goods with high YED (cars, international travel, luxury condos) saw disproportionately large demand falls. Meanwhile, demand for instant noodles, home cooking ingredients, and budget retail saw smaller declines or even increases (as goods with YED near 0 or negative).

## Cross Elasticity of Demand (XED)

### Definition Cross Elasticity of Demand

$$XED = \frac{\% \Delta \text{Quantity Demanded of Good X}}{\% \Delta \text{Price of Good Y}} = \frac{\Delta Q_X}{Q_X} \div \frac{\Delta P_Y}{P_Y}$$

Measures how responsive demand for Good X is to a change in the price of another Good Y.

### Interpreting XED

XED Value	Relationship	Example
$XED > 0$	Substitutes	MRT $\leftrightarrow$ Bus (high positive); Grab $\leftrightarrow$ Taxi
$XED = 0$	Unrelated	Cars $\leftrightarrow$ Bread
$XED < 0$	Complements	Cars $\leftrightarrow$ Petrol (high negative); Phones $\leftrightarrow$ Cases

**Magnitude Matters:**

- **High positive XED (e.g., +3):** Close substitutes. Consumers switch easily. Firms must compete on price.
- **Low positive XED (e.g., +0.3):** Weak substitutes. Consumers less willing to switch.
- **High negative XED (e.g., -2):** Strong complements. Goods are consumed in fixed proportions.

**Exam Tip XED and Market Definition**

XED is used to define market boundaries:

- High cross elasticity  $\Rightarrow$  goods are in the same market (fierce competitors)
- Low cross elasticity  $\Rightarrow$  goods are in separate markets

This is relevant for competition policy — authorities use XED to determine if two firms are competitors.

**Singapore Case Study XED: Transport in Singapore**

- **MRT and Bus:** High positive XED. When MRT fares rise, demand for buses increases significantly as commuters switch.
- **Car and Petrol:** High negative XED. When petrol prices rise, demand for cars falls (because the total cost of car ownership increases).
- **Grab and Taxi:** High positive XED. Consumers freely switch based on which is cheaper or more available.
- **COE and Used Car:** Positive XED. When COE prices rise (making new cars more expensive), demand for used cars rises.

**Price Elasticity of Supply (PES)****Definition Price Elasticity of Supply**

$$PES = \frac{\% \Delta \text{Quantity Supplied}}{\% \Delta \text{Price}} = \frac{\Delta Q_s}{Q_s} \div \frac{\Delta P}{P}$$

Measures how responsive quantity supplied is to a change in price. PES is **positive** (law of supply:  $P \uparrow \Rightarrow Q_s \uparrow$ ).

## Interpreting PES

Value	Term	Meaning
$PES = 0$	Perfectly inelastic	Fixed supply (vertical S curve). Example: seats at a concert
$0 < PES < 1$	Inelastic	Supply responds slowly. Example: agricultural crops in the short run
$PES = 1$	Unit elastic	Supply changes proportionally to price
$PES > 1$	Elastic	Supply responds strongly. Example: manufactured goods with spare capacity
$PES = \infty$	Perfectly elastic	Firms supply any amount at the market price. Example: a firm in perfect competition

## Determinants of PES

- Time period (most important):** Supply is more elastic in the long run. In the short run, firms are constrained by fixed factors (factory size, machinery). Over time, they can expand capacity, enter/exit markets, and adjust production techniques.
- Spare capacity:** Firms with idle factories and workers can increase output quickly (elastic supply). Firms at full capacity cannot (inelastic).
- Ease of storage:** Storable goods have more elastic supply (firms can increase market supply from inventories). Perishable goods have inelastic supply.
- Factor mobility:** If resources (labour, capital) can easily move between uses, supply is more elastic.
- Complexity of production:** Simple products (T-shirts) have more elastic supply than complex products (aeroplanes, specialised machinery).

### Singapore Case Study PES in Singapore: Housing

- **Short-run PES of housing:** Very inelastic. Construction takes 3–5 years. Land supply is constrained. Existing housing stock changes slowly.
- **Long-run PES of housing:** More elastic (but still constrained by land). Government can release more land for development (GLS Programme) and speed up approvals.
- **Implication:** A sudden increase in housing demand (due to population growth, low interest rates) primarily drives up prices in the short run because supply cannot respond quickly. This is exactly what happened in Singapore's property market 2020–2023.

### Exam Tip PES and Government Policy

PES is crucial for policy effectiveness:

- A tax on a good with inelastic supply mainly reduces producer surplus (producers cannot easily reduce quantity, so they absorb the tax)
- A subsidy on a good with inelastic supply mainly increases producer surplus (producers capture most of the subsidy benefit)
- Price controls on goods with inelastic supply create larger shortages/surpluses because quantity supplied cannot adjust much

## Government Intervention in Markets

### Why Governments Intervene

Markets can produce outcomes that are **inefficient** (market failure) or **inequitable**. Governments intervene to:

- Correct market failures (externalities, public goods, information failures)
- Achieve equity goals (affordable housing, minimum income, access to essentials)
- Stabilise prices and incomes (agricultural price supports)
- Protect consumers (product safety, price gouging bans)
- Achieve social objectives (public health via taxes on harmful goods)

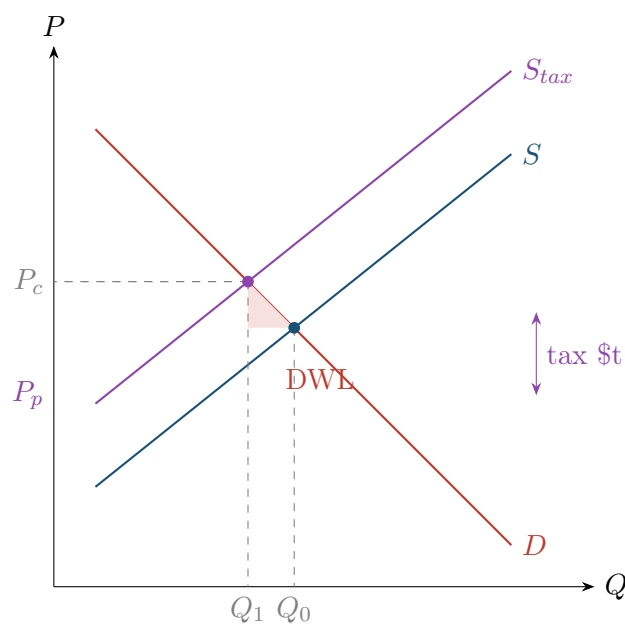
### Taxes (Indirect)

#### Definition Indirect Tax

A tax on expenditure, imposed on producers. It creates a **wedge** between the price consumers pay ( $P_c$ ) and the price producers receive ( $P_p$ ). The difference  $P_c - P_p = t$  is the per-unit tax.

#### Effects of a Per-Unit Tax

- Supply curve shifts **leftward/upward** by exactly  $t$
- Equilibrium:  $P$  rises (by less than  $t$ ),  $Q$  falls
- $P_c > P_e > P_p$  (consumers pay more, producers receive less)
- Government revenue =  $t \times Q_t$  (shown as rectangle between  $P_c$  and  $P_p$  at  $Q_t$ )
- CS decreases, PS decreases
- **Deadweight loss (DWL)**: The lost surplus from transactions that no longer occur (units between  $Q_t$  and  $Q_0$  that were previously bought and sold)



## Elasticity and Tax Impact

The side of the market with **more inelastic** behaviour bears the larger share of the tax:

- **Inelastic demand, elastic supply:** Consumers bear most of the tax ( $P_c$  rises significantly,  $P_p$  falls slightly). DWL is small. Government revenue is high. **Example:** Tax on cigarettes.
- **Elastic demand, inelastic supply:** Producers bear most of the tax ( $P_c$  rises slightly,  $P_p$  falls significantly). DWL is large. **Example:** Tax on luxury watches.

### Derivation Why Inelastic = Larger Burden

With inelastic demand, consumers cannot easily reduce quantity demanded when price rises. So when a tax increases the effective price, Qd does not fall much. Since the quantity traded barely changes, most of the tax is passed to consumers as a higher price. The DWL (lost trades) is small.

With elastic demand, consumers can easily switch to substitutes. So when price rises, Qd falls significantly. Producers cannot pass much of the tax as a higher price without losing most of their customers, so they absorb the tax. DWL is large.

### Singapore Case Study Tax: Singapore Carbon Tax

Singapore introduced a carbon tax of \$5/tCO<sub>2</sub>e in 2019, rising to \$25/t in 2024, and \$50–80/t by 2030. This is a Pigouvian (corrective) tax on carbon emissions:

- **Intended consequences:** Internalise the external cost of carbon emissions, incentivise firms to reduce emissions, generate revenue for green transition
- **Unintended consequences:** May reduce competitiveness of energy-intensive industries (petrochemicals, refining), could be regressive if passed to consumers via higher electricity prices
- **Effectiveness depends on PES:** In the short run, firms have limited ability to reduce emissions (inelastic supply of abatement)  $\Rightarrow$  tax mainly raises revenue. In the long run, as technology improves and firms invest in green solutions, the supply of abatement becomes more elastic  $\Rightarrow$  tax becomes more effective at reducing emissions

## Subsidies

### Definition Subsidy

A payment by the government to producers (per unit) to reduce production costs, lower market price, and encourage greater output/consumption.

### Effects of a Per-Unit Subsidy

- Supply curve shifts **rightward/downward** by exactly \$s
- $P$  falls (by less than  $s$ ),  $Q$  rises
- $P_c$  (consumers pay)  $< P_e < P_p$  (producers receive, including subsidy)
- CS increases, PS increases
- Government cost =  $s \times Q_{new}$  (the subsidy bill)
- Potential DWL if subsidy leads to overproduction (units where  $MC > MB$ )

### Singapore Case Study Subsidy: HDB Housing Grants

Singapore provides significant subsidies for public housing:

- **First-timer grants:** Up to \$80,000 for families buying new BTO flats
- **Enhanced CPF Housing Grant:** Up to \$120,000 for lower-income families
- **Effect:** Shifts supply of affordable housing rightward (or effectively shifts the price consumers pay down). Increases homeownership (over 90% homeownership rate).
- **Evaluation:** Effective in achieving equity (housing affordability) but expensive (fiscal cost). May distort market signals — artificially low prices encourage overconsumption of housing space. Risk of creating dependency on subsidies.

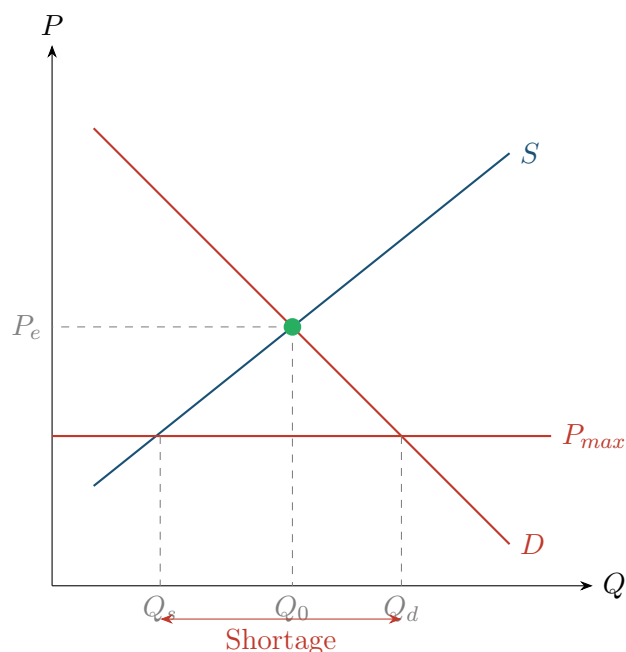
### Price Ceiling (Maximum Price)

#### Definition Price Ceiling

A legally imposed maximum price set **below** the equilibrium, intended to make essential goods affordable. The government decrees that the good cannot be sold above this price.

#### Effects

- **Shortage:**  $Q_d > Q_s$  at  $P_{max}$  — persistent excess demand
- **Non-price rationing:** Queues, waiting lists, favouritism, black markets (where the good sells illegally at market price)
- **Consumer surplus:** Increases for those who obtain the good (pay less); decreases for those who are excluded from the market entirely
- **Producer surplus:** Decreases (lower price, lower quantity)
- **DWL:** Lost surplus from trades that would have occurred between  $Q_s$  and  $Q_0$
- **Quality deterioration:** Since producers cannot compete on price, they compete on quality — but they also have less incentive to maintain it (or they cut quality to reduce costs at the lower price)



### Example Price Ceiling: Rent Control (International Example)

In New York City, rent-controlled apartments are a classic price ceiling. Effects observed:

- **Shortage:** Apartments are very scarce; waiting lists can be years long
- **Black market:** Key money (illegal upfront payments to landlords) for rent-controlled units
- **Quality deterioration:** Landlords have little incentive to maintain properties (no price competition)
- **Misallocation:** A wealthy family living in a large rent-controlled apartment they no longer need because it's cheaper than moving

Singapore does NOT impose rent control, preferring instead to subsidise homeownership (HDB) and provide means-tested rental assistance. This avoids the inefficiencies of price ceilings.

### Price Floor (Minimum Price)

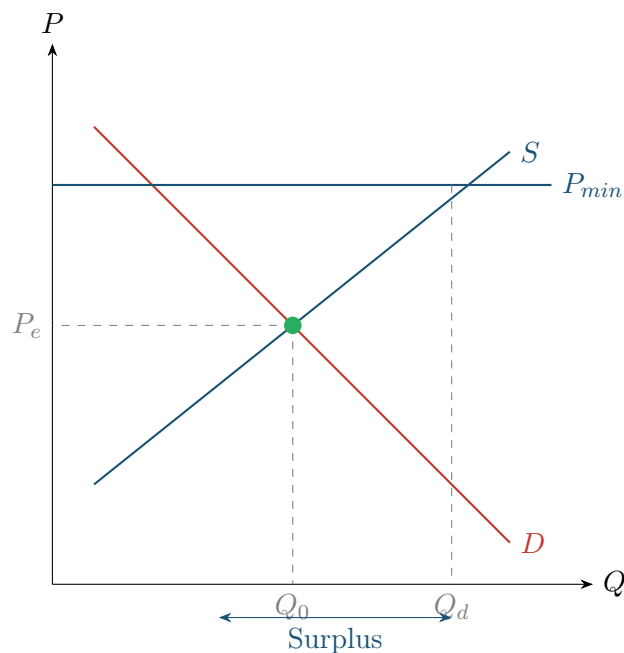
#### Definition Price Floor

A legally imposed minimum price set **above** the equilibrium, intended to protect producers' incomes. The government decrees that the good cannot be sold below this price.

#### Effects

- **Surplus:**  $Q_s > Q_d$  at  $P_{min}$  — persistent excess supply
- Government may need to purchase the surplus (costly and wasteful)
- CS decreases (higher prices, fewer units consumed)
- PS may increase (for producers who sell at the higher price), but some producers are left with unsold goods
- DWL from lost transactions (units between  $Q_d$  and  $Q_0$ )

- Wasteful activities: storage of surplus, dumping, rent-seeking



### Singapore Case Study Price Floor: Progressive Wage Model

Singapore does NOT have a universal minimum wage. Instead, it uses the **Progressive Wage Model (PWM)** — sector-specific minimum wages tied to skills upgrading:

- **Sectors:** Cleaning, security, landscape, lift maintenance, retail
- **Mechanism:** Instead of a flat price floor, PWM sets a wage ladder — wages increase as workers complete training and gain skills
- **Effect:** Raises wages above market-clearing levels (like a price floor) but mitigates unemployment through the training requirement (workers become more productive, justifying higher wages)
- **Evaluation:**
  - **FOR:** Addresses income inequality without causing the unemployment that a universal minimum wage might create; incentivises upskilling; politically sustainable
  - **AGAINST:** Covers limited sectors (only 10% of low-wage workers); administratively complex; may increase costs for businesses (passed to consumers)

## Quantity Controls (Quotas)

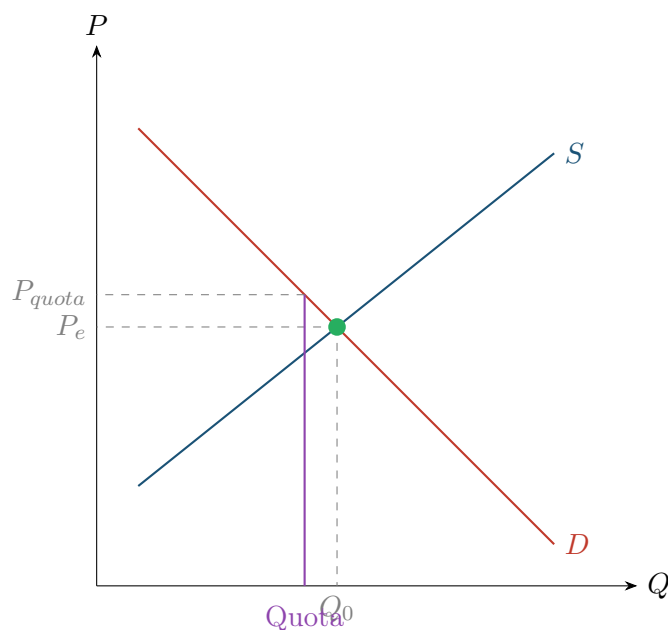
### Definition Quota

A legal limit on the quantity of a good that can be produced, imported, or sold. A direct **quantity restriction** rather than a price-based intervention.

### Effects of a Quota

- Supply becomes **vertical at the quota quantity** (perfectly inelastic beyond that point)
- $P$  rises (scarcity is artificially created),  $Q$  falls to the quota level
- CS decreases (higher price, lower quantity)

- PS may increase (producers who hold quota rights earn a premium — quota rent)
- **Quota rent:** The difference between the market price and the marginal cost at the quota quantity — a windfall gain for quota holders
- DWL from lost trades



### Singapore Case Study Quota: The COE System

Singapore's Vehicle Quota System (VQS) is the most well-known quota in Singapore:

- **How it works:** The government sets an annual quota for new vehicle registrations, calculated as:  $\text{Quota} = \text{Projected de-registrations} + \text{Allowable vehicle population growth rate}$  (currently 0% growth from Feb 2023)
- **Mechanism:** COEs are auctioned through a sealed-bid Uniform Price auction — all successful bidders pay the lowest successful bid price (the quota price)
- **Effects:**
  - Supply of new cars is artificially restricted  $\Rightarrow$  prices are high
  - Creates a secondary market for COEs (used cars with remaining COE)
  - COE prices are volatile (demand-driven fluctuations in a fixed supply)
- **Evaluation:**
  - **FOR:** Effectively controls vehicle population growth; prevents congestion from worsening; generates government revenue; transparent system
  - **AGAINST:** High COE prices reduce accessibility (inequity — car ownership becomes luxury good); creates windfall gains for existing COE holders (quota rent); price volatility creates uncertainty
  - **Alternative:** Congestion pricing (ERP) instead of quantity restrictions — allows market to determine who drives, not just who owns a car

## Comparing Intervention Tools

Tool	Price Effect	Quantity Effect
Tax	Price rises (by less than \$t)	Quantity falls
Subsidy	Price falls (by less than \$s)	Quantity rises
Price Ceiling	Artificially low (below $P_e$ )	Shortage ( $Q_d > Q_s$ )
Price Floor	Artificially high (above $P_e$ )	Surplus ( $Q_s > Q_d$ )
Quota	Price rises (artificially)	Falls to quota level

### Exam Tip Choosing Between Interventions

When a question asks you to discuss the best policy:

1. Identify the market failure/goal (efficiency? equity? quantity control?)
2. Compare 2–3 policy options using the Big Nine evaluation criteria
3. Consider Singapore-specific constraints (small, open economy; land scarcity; administrative capacity)
4. Make a clear recommendation with justification

## Application Case Studies for Exams

### Case Study: Singapore's Carbon Tax

#### Singapore Case Study Carbon Tax: A Complete Theme 2.1 Application

**Context:** Singapore introduced a carbon tax of \$5/tCO<sub>2</sub>e in 2019, rising to \$25/t in 2024, with plans to reach \$50–80/t by 2030.

#### Demand-Supply Analysis:

- Carbon emissions are a by-product of production — firms treat the atmosphere as a free dumping ground (negative externality, covered in Theme 2.4, but the tax mechanism is Theme 2.1)
- The carbon tax shifts the supply curve of carbon-intensive goods leftward (increases production cost)
- Higher prices incentivise firms to reduce emissions (substitute cleaner energy, invest in efficiency)

#### Elasticity Considerations:

- In the short run, demand for energy is inelastic ( $PED < 1$ )  $\Rightarrow$  firms pass most of the tax to consumers as higher prices, and revenue is high
- In the long run, as technology improves and substitutes become available (solar, hydrogen, carbon capture), demand becomes more elastic  $\Rightarrow$  the tax becomes more effective at reducing emissions
- PES of abatement technology is inelastic in SR (firms cannot quickly install solar panels or switch fuel sources) but elastic in LR

#### Intervention Evaluation:

- **Price-based:** Market-conforming, allows firms to find least-cost method of abatement
- **Revenue:** Estimated \$1 billion/year by 2030, can be used for green transition or to offset GST for households
- **Limitation:** Regressive (poor households spend a higher share on electricity). Singapore addresses this with GST vouchers and U-Save rebates.

## Case Study: Price Mechanism in Transport (ERP, COE, Fares)

### Singapore Case Study Transport Policy: Theme 2.1 Compilation

- **ERP (Price Mechanism):** Variable road pricing charges. Higher ERP during peak hours signals congestion, incentivises off-peak travel, rations scarce road space. Price adjusts by time and location. Fully market-conforming.
- **COE (Quota):** Quantity control. Government sets vehicle population growth rate (currently 0%), quota determined by de-registrations. Price determined by auction. COE prices reached record highs (\$106K for Cat A in 2023) because demand for cars is inelastic and supply is fixed.
- **Public Transport Fares (Regulated Price):** Not purely market-determined. The Public Transport Council sets fare adjustment formula based on CPI, wage index, and productivity. This is a form of price regulation — not a ceiling or floor, but a formula-driven adjustment that balances affordability (equity) with operator financial sustainability.
- **Grab Surge Pricing (Price Mechanism):** When demand exceeds supply (peak hours, rainy days, concerts), prices rise. The higher price incentivises more drivers to enter the area (incentive) and rations scarce rides to those who value them most (rationing). Signal: “more drivers needed here.”

## Case Study: Post-COVID Inflation

### Singapore Case Study Supply vs Demand Shocks in Theme 2.1 Language

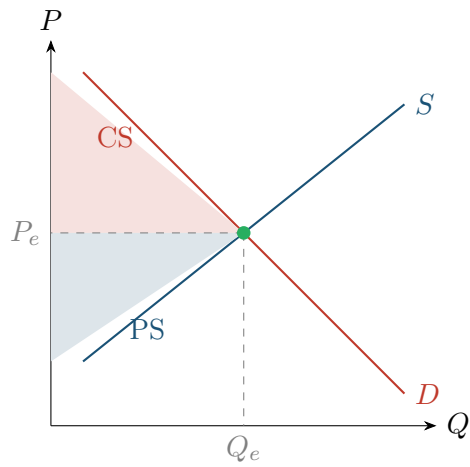
Post-COVID inflation (2021–2023) was driven by simultaneous D and S shifts:

- **Supply shocks (S ↓):** Supply chain disruptions, shipping container shortages, semiconductor shortages, labour shortages, energy price spikes (Russia-Ukraine war). S curves shifting left.
- **Demand shifts (D ↑):** Fiscal stimulus (COVID support packages), pent-up demand released after reopening, low interest rates (cheap borrowing). D curves shifting right.
- **Net:**  $D \uparrow + S \downarrow = P$  unambiguously  $\uparrow$  (which is what we observed — high inflation)

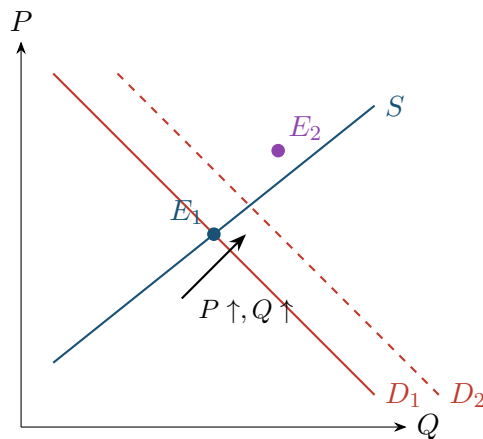
This analysis shows why simultaneous D&S shifts are tested: they perfectly explain real-world macroeconomic phenomena using only Theme 2.1 tools.

## Diagram Reference: All Key Diagrams

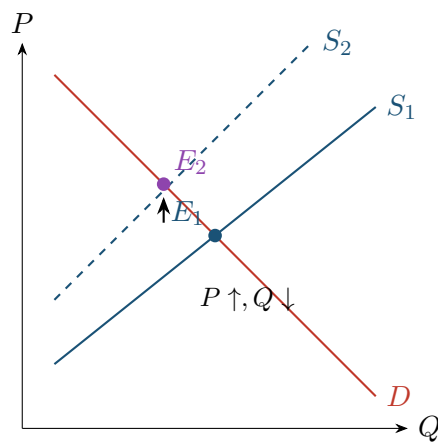
### Basic D&S Equilibrium with CS and PS



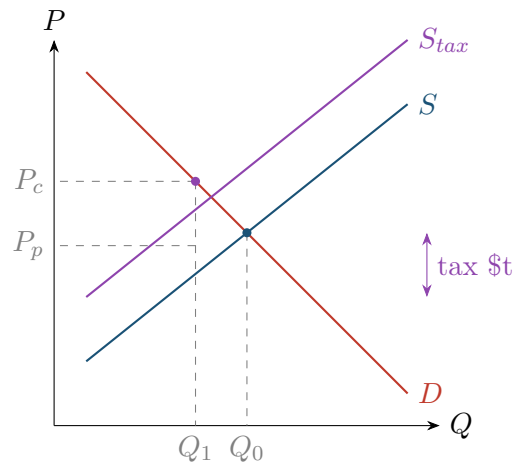
### Demand Increase (Right Shift)



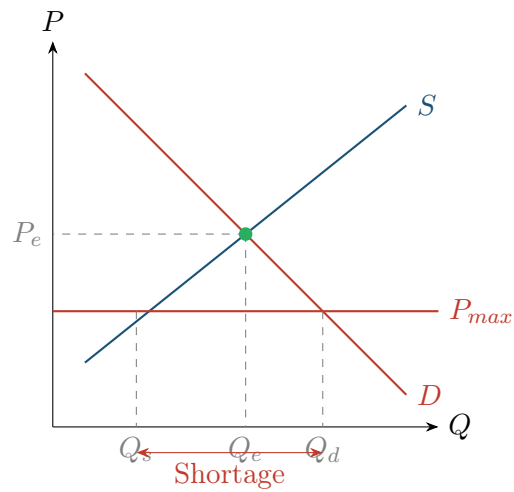
### Supply Decrease (Left Shift)



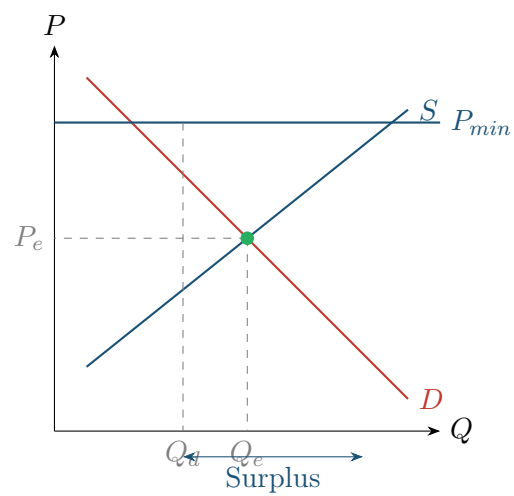
**Tax**



**Price Ceiling**



**Price Floor**



Quota

