CB2402 Macroeconomics - Review

Macroeconomics is the study of the economy as a whole, focusing on aggregate measures and the interactions between different sectors.

Two types of analysis:

- **Positive analysis**: What will happen? (descriptive)
- **Normative analysis**: What (policy) should be done? (prescriptive, judgmental)

GDP

Gross Domestic Product (GDP): The total market value of all **final goods and services** produced within a country in a given period of time (a year).

- Final goods and services: Goods and services that are sold to the final user. Intermediate goods are produced, brought, and used in the production of final goods and services.
- Domestic means the activity takes place within the borders of a country, regardless of the nationality of the producer.

Expenditure approach

$$GDP = C + I + G + (X - IM)$$

Where:

- C = **Consumption** (durables, semi-durables e.g. clothing, non-durables e.g. food, services)
- I = **Investment** (business fixed investment = buy capital goods, residential fixed investment = construct new homes, inventory investment = change in unsold goods)
- G = **Government spending**
- **Net exports** = X - IM (exports - imports)

Not included in GDP:

- Financial transactions (e.g. stocks, bonds, real estate) - no production of goods and services. However the commission paid to brokers is included in GDP (Investment section).
- Purchase of houses - new houses are included in the investment section; existing houses have been previously counted in GDP when they were built.
- Transfer payments (e.g. unemployment benefits, pensions) - no production of goods and services.

Income approach

$$GDP = \text{Labor income} + \text{Capital income}$$

Where:

- **Labor income** = wages, salaries, benefits, etc.
- **Capital income** = land rent, interest (dividends), royalty payments, owner's profits, etc.

- **Nominal GDP** = GDP in current prices; **Real GDP** = GDP in constant prices (adjusted for inflation).

- $\text{GDP per capita} = \text{GDP} \div \text{Population}$

GDP does not measure:

- Out-of-market transactions (e.g. illegal, underground, home production)
- Economic bad (e.g. pollution, crime); Environmental degradation; Economic good (e.g. leisure time, health, education); Income inequality

Inflation

CPI

Consumer Price Index (CPI): A measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services.

Denote base year price as P_0, quantity as Q_0, and current year price as P_1: (Note today's consumption quantities are irrelevant)

$$\text{CPI} = \frac{\sum P_1 \cdot Q_0}{\sum P_0 \cdot Q_0} \times 100$$

- **Core CPI**: Excludes food and energy prices.
- **Producer Price Index (PPI)**: Measures selling prices received by domestic producers for their output.
- **Import/Export Price Index**: Measures the price of imports and exports.

Biases in CPI:

- **Quality adjustment bias**: CPI does not account for quality improvements in goods and services.
- **Substitution bias**: CPI does not account for consumers substituting cheaper goods for more expensive ones.

Inflation rate

$$\text{Inflation rate} = \frac{\text{CPI}_1 - \text{CPI}_0}{\text{CPI}_0} \times 100$$

$$\text{Real value} = \frac{\text{Nominal value}}{\text{CPI}} \times 100$$

Note CPI inflation is different from the inflation in the price of a single good, nor the inflation in the daily cost of living. When inflation rate decreases, it does not mean prices are falling, but that they are increasing at a slower rate.

Response to changing prices is tentative and slow because buyers and sellers cannot tell if the price change is product-specific or economy-wide.

Costs of inflation:

- Distortion caused by taxes (tax and allowance based on nominal income)
- Increased cost of holding money (shoe leather costs: time and effort spent to go to the bank)
- Unexpected redistribution of wealth (e.g. loans greatly depreciate in value causing a transfer of wealth from lenders to borrowers)
- Interference with long-term planning

Interest rates

$$\text{Real interest rate} = \text{Nominal interest rate} - \text{Inflation rate}$$

$$r = i - \pi$$

Fisher effect: when inflation increases, nominal interest rates increase.

Economic growth

$$\frac{Y}{POP} = \frac{Y}{N} \cdot \frac{N}{POP}$$

where $\frac{Y}{POP}$ = real GDP per capita, $\frac{Y}{N}$ = real GDP per worker, and $\frac{N}{POP}$ = employment-to-population ratio.

Six factors of economic growth:

- Human capital (education, training)
- Physical capital (tools, machines, buildings; **Diminishing returns**: as more capital is added, the additional output produced by each unit of capital decreases)
- Land and other natural resources (e.g. energy, raw materials)
- Technology
- Entrepreneurship (ability to create new business) and management (ability to coordinate production)
- Political stability and economic institutions (protecting **property rights**)

Government policies to promote growth:

Supports education and training; encourages new capital formation (e.g. tax incentives); promotes research and development; maintains a stable socio-political environment.

Costs of growth:

Fewer consumer goods, reduced leisure time; health, safety, and environmental costs; R&D, education, and infrastructure are costly

Labor market

Unemployment

- **Employment**: The number of working-age people who have a job.
- **Unemployment**: The number of working-age people who are not working but are actively looking for a job.
- $\text{Working-age population} = \text{Employed} + \text{Unemployed} + \text{Out of labor force}$
- $\text{Labor force} = \text{Employed} + \text{Unemployed}$
- $\text{Unemployment rate} = \text{Unemployed} \div \text{Labor force}$
- $\text{Participation rate} = \text{Labor force} \div \text{Working-age population}$

Costs of unemployment: economic costs (lost output, increased transfer payments), psychological costs, social costs.

- **Discouraged workers**: People without jobs who have given up looking for work. They are **out of the labor force**.

- **Involuntary part-time workers**: People who want to work full-time but can only find part-time work. They are **employed**.

3 types of unemployment:

- **Frictional**: Short-term, voluntary unemployment that occurs when people are between jobs (or new graduates).
- **Cyclical**: Unemployment caused by a business cycle recession.
- **Structural**: Unemployment caused by a persistent mismatch between the skills of workers and the requirements of jobs. Causes: barrier (skills, language), structural change (technology, globalization), regulation (minimum wage, unemployment benefits, health and safety regulations), geographic mismatch.

Labor demand

[Graph] X axis: Q = employment, Y axis: P = real wage

- **Downward sloping**
- **Diminishing marginal returns**: as more labor is added, the additional output produced by each unit of labor decreases. **Value of marginal product (VMP)**: the additional revenue generated by one more unit of labor.

Shifts to the right (increase) when:

- the company's output price increases
- the productivity of labor increases (e.g. new technology, better training)

Labor supply

Reservation wage: the minimum wage a worker is willing to accept for a job. At this wage, the wage compensates for the opportunity cost of leisure. Higher for dangerous or unpleasant working conditions.

Upward sloping: as the wage rate increases, more people are willing to work.

The quanity of labor supplied is affected by:

- Size of working-age population (domestic age structure; im- and emigration; age of entry and exit from the labor force)
- % of working-age population willing to work

Shifts to the right (increase) when these two factors increases.

Labor market equilibrium

5 trends in US labor market:

(1) Increase in real wages. Explanation: increase in labor productivity (capital accumulation, technology), increase in demand for labor grows faster than supply.

(2) Stagnation of real wages since 1970s. Explanation: increase in demand has slowed down, increase in supply has grown faster.

(3) Increase in wage inequality. Explanation: increase in demand for skilled labor (technology), increase in supply of unskilled labor (competition from developing countries). **Skill-biased technological change**: technology increases the productivity of skilled labor more than unskilled labor.

(4) Number of jobs grown faster than population.

(5) Lower unemployment rate than the European. Explanation: European labor market is more regulated (higher minimum wage, little flexibility in benefits, more powerful unions).

Saving

$$\text{Saving} = \text{Income} - \text{Consumption}$$

$$\text{Saving Rate} = \text{Saving} \div \text{Income}$$

$$\text{Wealth} = \text{Assets} - \text{Liabilities}$$

- **Flow**: a quantity measured over a period of time (e.g. income, saving, consumption per year)
- **Stock**: a quantity measured at a point in time (e.g. wealth, debt at the end of the year)
- Flow of savings adds to the stock of wealth.
  $\Delta\text{Wealth} = \text{Saving} + \text{Capital gains} - \text{Capital losses}$

3 reasons for saving: **Life-cycle** (retirement), **Precautionary** (unexpected expenses), **Bequest** (inheritance).

National saving

$Y = C + I + G + (X - IM)$

Private saving $S_p = Y - C - T$

Public saving $S_g = T - G$

where $T = \text{Taxes} - \text{Transfer payments} - \text{Gov interest payments}$ is the net taxes.

When $T > G$, the government is running a **budget surplus**. When $T < G$, the government is running a **budget deficit**.

National saving $S = S_p + S_g = Y - C - G$

Benefits: Higher national saving rate = more capital investment = higher productivity = higher standard of living.

How to increase national saving: reduces government deficit (cut spending); increases incentives for household saving (tax exemption on dividends and investment income).

Capital formation

Investment: the purchase of new capital goods.

According to **Cost-benefit principle**, firms will invest in capital until
$\text{Marginal benefit} = \text{Marginal cost}$.

- Cost is purchasing and maintaining the capital goods. Affected by price of the capital, real interest rate.
- Benefit is the additional revenue generated by the capital goods. Positively affected by technical innovation, lower taxes, higher output prices.

- **Supply of savings** S: The amount of savings available at each interest rate. Upward sloping.
- **Demand for investment** I: the amount of savings borrowed to buy new capital goods at each interest rate. Downward sloping.
- [Graph] X axis: S, I = saving or investment; Y axis: r = real interest rate
- When r increases, S increases and I decreases. **Equilibrium real interest rate**: r^* where $S = I$.
- If $r > r^*$, there is a surplus of savings. If $r < r^*$, there is a shortage of savings.

Shifts in the demand: Technological innovation = ↑ in marginal product of capital = ↑ in demand for investment = demand curve shifts to the right = ↑ interest rate = ↑ savings.

Shifts in the supply: Increase in government deficit = ↓ in national saving = supply curve shifts to the left = ↑ interest rate = ↓ investment = private sector is crowded out by government borrowing.

Banking system

Goal: allocate savings to the most productive investments.

The banking system is a network of **financial intermediaries** that channel funds from savers to borrowers. Commercial banks accept deposits and make loans; when loans are paid back with interest, banks keep a portion of the interest as profit and pay the rest to depositors as interest on their deposits.

The banking system improves the allocation of savings by: providing information to savers about the risk and return of different investments; pooling savings from many savers to make large loans to spread out risk. They specialize in evaluating the quality of borrowers (e.g. creditworthiness).

Mutual funds: a company that pools money from many investors to buy stocks, bonds, and other securities. They provide diversification (spreading risk) and liquidity (easy to buy and sell shares).

Bond

Bond: a **legal promise** to repay a debt with interest.

- **Principal amount**: the amount borrowed.
- **Maturation date**: the date the bond must be repaid. **Term**: the time until the bond matures.
- **Coupon payment**: the interest payment made to the bondholder over the life of the bond.
- **Coupon rate**: $\text{Coupon payment} \div \text{Principal amount}$

Coupon rate depends on bond's term, risk, and liquidity. Longer term, higher risk, and less liquid bonds have higher coupon rates.

Bonds can be traded. The price of a bond is the present value of its future cash flows (coupon payments and principal repayment). **Second-hand bond prices and today's interest rates are inversely related**.

e.g. A n-year bond with face value P_0, coupon rate c, sold in a market with interest rate i.

- After n years, the bondholder receives $P_0 + c \cdot P_0 = P_0(1 + c)$.
- To repay the same amount with interest rate i, its value today is given by $P_1 \cdot (1 + i)^n = P_0(1 + c)$. So $P_1 = \frac{P_0(1+c)}{(1+i)^n}$.

Stock

A share of stock is a claim to partial ownership of a firm.

- **Dividends**: the portion of a firm's profits paid to shareholders. Paid regularly per each share they own.
- **Capital gains**: the increase in the value of a share of stock over time, deteremined in the stock market.

e.g. After 1 year, a share of stock worth P_0 pays a dividend of d. The interest rate is i. The price of the stock today is given by $P_1 \cdot (1+i) = P_0 + d$. So $P_1 = \frac{P_0+d}{1+i}$.

Risk premium: $\text{Expected return} - \text{Risk-free rate}$

- **Risk-free rate**: the return on a risk-free asset (e.g. US Treasury bonds). The interest rate on a bond with no risk of default.
- Risk aversion increases the return required by investors to hold risky assets, and according to $P_1 = \frac{P_0+d}{1+i}$, the price of the stock decreases.

International capital flows

- **Capital inflow**: foreigners buy US assets.
- **Capital outflow**: US residents buy foreign assets.
- **Net capital inflow** KI: capital inflow - capital outflow.

[Graph] $KI - r$ graph: X axis: KI = net capital inflow; Y axis: r = domestic real interest rate.

- **Upward sloping**: as the interest rate increases, the return on US assets increases, attracting more foreign investment.
- Shifts to the left when risk increases: higher risk = foreigners buy less + domestic residents buy more foreign assets = net capital outflow increases.

$Y = C + I + G + NX, S = Y - C - G, NX + KI = 0$

$I = S + KI$ (In a closed economy, $I = S$).

- $NX > 0$ = trade surplus = $KI < 0$ = capital outflow.
- $NX < 0$ = trade deficit = $KI > 0$ = capital inflow.

Role of ICF: Efficient allocation of savings across countries. Savers in one country can invest in the most productive investments in another country, which fills the saving gap in developing countries.

What causes trade deficits: lower national saving = higher spendings = higher imports + lower exports = trade deficit.

Countries in trade deficits receive capital inflows = increased interest rates = increased investment = increased GDP.

Money

Money: any asset that is generally accepted as a medium of exchange.

Functions of money: **medium of exchange**, **store of value**, **unit of account**.

Bitcoin is not money nor included in the money supply because it is not widely accepted as a medium of exchange, and it is not a stable store of value.

- M1 = cash + checking accounts + travelers' checks (most liquid form of money)
- M2 = M1 + savings accounts + money market accounts + small time deposits + other near-money assets

Quantity equation $MV = PY$ where M = money supply, V = velocity of money (the number of times a dollar is spent in a year), P = price level, Y = real GDP. Alternatively, $V = \frac{PY}{M} = \frac{\text{Nominal GDP}}{\text{Money supply}}$.

In the long run, the amount of money in the economy determines the price level.

Monetizing the debt: When the government borrows money by selling bonds to the central bank, which creates new money to buy the bonds. If the money supply grows faster than the economy, it leads to inflation.

Commercial banks

Commercial banks: financial institutions that accept deposits and make loans.

- **Bank reserves**: the amount of money banks hold in reserve to meet withdrawal demands. **Reserve ratio**: $\text{Reserves} \div \text{Deposits}$.
- Loans are spent and redeposited in other banks, creating new deposits. This is called the **money multiplier**: $\text{Money supply} = \text{Deposits} \div \text{Reserve ratio}$.

e.g. If the public has C in cash, the bank has D in deposits, and the reserve ratio is r, then the money supply is $M = C + \frac{D}{r}$. The money supply is positively related to the bank deposits.

Federal Reserve

Federal Reserve: the central bank of the US. It regulates the money supply and interest rates to promote economic stability and growth.

Two responsibilities: conduct monetary policy (control the money supply and interest rates); oversee and regulate the banking system.

Fed's tool - **Open market operations**: When the Fed buys bonds from banks, it increases the reserves of the banking system, which increases the money supply.

Banking panics: When depositors withdraw their deposits, banks must sell their assets to meet the demand for cash. This can lead to a **bank run**, where many depositors withdraw their deposits at the same time, causing the bank to fail. **Deposit insurance**: a government guarantee that depositors will be repaid their deposits even if the bank fails. This reduces the risk of bank runs.

Short-run economic fluctuations

Business cycle: the fluctuations in economic activity over time. It consists of four phases: expansion, peak, contraction, and trough.

Phenomena: cyclical unemployment, durable goods spending (more affected by business cycles than non-durable goods), inflation rates (generally increase during expansions and decrease during contractions).

Output gap

Potential output Y^*: the level of output that an economy can produce when all resources are fully employed. It is the long-run trend of output.

$\text{Output gap} = \frac{Y-Y^*}{Y^*}$

Natural rate of unemployment u^*: sum of frictional and structural unemployment. Cyclical unemployment is the difference between actual unemployment and natural rate of unemployment.

- **Recessionary gap**: $Y < Y^*, u > u^*$
- **Inflationary gap**: $Y > Y^*, u < u^*$

Okun's law: +1% unemployment = -2% output. $\frac{Y-Y^*}{Y^*} \approx -2(u-u^*)$

Reasons of output gap:

- Markets need time to reach new equilibrium price and quantity
- Changes in economy-wide spending affects output level. Less spending = less demand = less output = less employment = less income = less spending (multiplier effect).

Short run = time horizon in which wages and prices are sticky. **Long run** = period over which wages and prices have time to adjust.

Self-correcting mechanism: firms eventually adjust to output gaps:

- If spending < potential output, firms will slow the increase in prices.
- If spending > potential output, firms will increase the prices.

Keynesian model

In the short run, firms set a price and meet demand at that price. They do not adjust prices to meet demand. The economy is demand-driven.

In the long run, the output is only determined by the productive capacity of the economy. Spending only affects the price level.

Menu costs: the costs of changing prices. Firms change prices when MB > MC.

Planned aggregate expenditure (PAE)

$\text{PAE} = C + I + G + NX$

Consumption function: $C = C_0 + \text{MPC} \cdot (Y - T)$

Where:

- C_0 = autonomous consumption (consumption when income is zero)
- MPC = marginal propensity to consume (the fraction of additional income that is consumed) $\text{MPC} = \frac{\Delta C}{\Delta (Y-T)}$
- **autonomous spending** $k = C_0 - \text{MPC} \cdot T + I + G + NX$
- **induced spending** $= \text{MPC} \cdot Y$

Wealth effect: higher asset prices = higher wealth = higher consumption.

Interest rate effect: higher interest rates = higher cost of borrowing = lower consumption (especially for durable goods).

Short run equilibrium: PAE = Y, i.e. $\text{MPC} \cdot Y + k = Y$

If current output is below short-run equilibrium, planned spending > actual output, inventory is decreasing, firms increase production and employment, and output increases.

Income expenditure multiplier: the ratio of the change in equilibrium output to the change in autonomous spending. It is equal to $\frac{1}{1-\text{MPC}}$. i.e. A change in non-income spending leads to a larger change in output.

Example: If MPC = 0.8, C_0 is decreased by \$10, then Y will decrease by \$50.

Stabilization policy

Government policies to stabilize the economy and reduce the severity of business cycles.

- **Expansionary**: increase PAE to stimulate the economy.
- **Contractionary**: decrease PAE to slow down the economy.
- **Fiscal**: government spending G and taxes T.
- **Monetary**: money supply M and interest rates i.

Fiscal policy: In the above example, to offset \$10 decrease in C_0, the government can increase G by \$10, or decrease T by \$12.5 (as $\text{MPC} \cdot \Delta T + \Delta C_0 = 0$).

Limitations of fiscal policy: time lags (recognition lag, implementation lag, impact lag), competing political priorities (e.g. tax cuts vs. spending).

	Fiscal	**Monetary**
Expansionary	$G \uparrow, T \downarrow$ $r \uparrow, e \uparrow$	$M \uparrow, i \downarrow$ $r \downarrow, e \downarrow$
Contractionary	$G \downarrow, T \uparrow$ $r \downarrow, e \downarrow$	$M \downarrow, i \uparrow$ $r \uparrow, e \uparrow$

Monetary policy

Money demand

Money demand M_D: the amount of wealth people want to hold in the form of money. People balance between MC (interest foregone) and MB (liquidity) of holding money.

- Higher nominal interest rate i = lower money demand
- Higher real income Y = higher money demand
- Higher price level P = higher money demand (according to $V = \frac{PY}{M}$, money is circulating faster)

[Graph] X axis: M_D = money demand; Y axis: i = nominal interest rate. Downward sloping.

Shifts in money demand curve:

- Increase in output = $M_D \uparrow$ = shift to the right
- Financial advances = $M_D \downarrow$ = shift to the left (e.g. ATMs, debit cards)

- Foreign demand for US dollars increases = $M_D \uparrow$ = shift to the right

Money supply

Money supply M_S: the amount of money available in the economy. It is controlled by the central bank (e.g. Federal Reserve).

Fed can control the nominal interest rate by changing the money supply. ↑ money supply = ↓ interest rate.

- To decrease money supply, Fed sells bonds to public = ↑ supply of bonds = ↓ price of bonds = ↑ interest rate = ↓ money supply.
- To increase money supply, Fed buys bonds from public = ↑ demand for bonds = ↑ price of bonds = ↓ interest rate = ↑ money supply.

Fed cannot separately control the money supply and interest rate. It can only target one of them.

- **Zero lower bound**: If the country sets zero lower bound, the central bank cannot lower interest rates below zero. This limits the effectiveness of monetary policy. However, even in countries with negative interest rates, it cannot go far below zero.
- **Quantitative easing**: Fed buys long-term bonds to increase the money supply and lower long-term interest rates. It is used when the economy is in a liquidity trap (interest rates are at zero).
- **Forward guidance**: Fed communicates its future monetary policy intentions to influence expectations and behavior of consumers and investors.
- **Interest on reserves**: Fed pays interest on reserves held by banks, even at a interest rate of zero. This can influence banks' willingness to lend and the money supply.

Federal funds rate = interest rate at which banks lend reserves to each other overnight.

Discount rate = interest rate at which banks can borrow from the Fed. (> federal funds rate and < market interest rate).

Policy reaction function: the relationship between the Fed's target interest rate and the state of the economy.

Taylor rule: $i = r + \pi + 0.5(\pi - \pi^*) + 0.5(\frac{Y - Y^*}{Y^*})$

Where: i = target interest rate, r = real interest rate, π = inflation rate, π^* = target inflation rate, $\frac{Y - Y^*}{Y^*}$ = output gap.

Suppose $C = 640 + 0.8(Y - T) - 400r$, $I^P = 250 - 600r$, $G = 300$, $NX = 20$, $T = 250$, $Y^* = 5000$

$$PAE = C + I^P + G + NX = 1010 + 0.8Y - 1000r$$

Recall that in a recessionary gap, $r \downarrow$ = $C + I^P \uparrow$ = $PAE \uparrow$ = $Y \uparrow$, allowing the economy to self-correct.

Suppose $r = 0.05$, short-run equilibrium $Y = PAE = 960 + 0.8Y, Y = 4800$

There is a recessionary gap of $Y^* - Y = 200$. Monetary policy can be used to increase PAE by decreasing r:

$$\Delta PAE = -1000 \cdot \Delta r + 0.8 \cdot \Delta Y = \Delta Y, \Delta Y = 200$$

$\Delta r = \frac{200 \div 5}{-1000} = -0.04$

New interest rate $r = 0.01$

A reduction in r shifts the expenditure line upward (less incentive to save = more spending) and closes the recessionary gap.

Aggregate demand and supply

Aggregate demand

[Graph] X axis: Y = real GDP; Y axis: π = inflation rate

Downward sloping. Explained by:

- Policy reaction function: inflation rate $\pi \uparrow$ = real interest rate $r \uparrow$ = planned spending $\downarrow$ = $Y \downarrow$.
- Distributional effects: inflation hurts low-income households more, who also spend a larger share of their income. This reduces consumption.
- Uncertainty: inflation creates uncertainty about future prices, which reduces investment and consumption.
- Exports: inflation = higher prices exports = lower demand for US goods = lower output.

Shifts in AD curve: changes in **exogenous spending** (e.g. government spending G, taxes T, foreign demand NX); changes in Fed's reaction function.

A tight monetary policy = real interest rate $r \uparrow$ = $Y \downarrow$ = AD curve shifts to the left.

Inflation inertia: the tendency of inflation to persist even after the underlying causes have changed. Caused by **inflation expectation** and long-term contracts (e.g. wages, rents).

Aggregate supply

[Graph] X axis: Y = real GDP; Y axis: π = inflation rate

- **Long-run aggregate supply (LRAS)**: a vertical line at the potential output Y^*. In the long run, output is only determined by the productive capacity of the economy.
- **Short-run aggregate supply (SRAS)**: a horizontal line at current inflation rate π.
- Short-run equilibrium: intersection of AD and SRAS curve. A situation where given the current inflation rate, the economy is at full employment, so the equilibrium output is at the current potential level.
- Long-run equilibrium: intersection of AD and LRAS curve. A situation where the economy is at full employment.

Usually there is no intersection between AD and LRAS curve. We need to adjust the inflation rate so that SRAS, LRAS, and AD curves intersect at the same point.

- Expansionary gap $Y > Y^*$ = high inflation $\pi > \pi^*$ = low unemployment $u < u^*$, LRAS is to the left of short-run equilibrium.
- Recessionary gap $Y < Y^*$ = low inflation $\pi < \pi^*$ = high unemployment $u > u^*$, LRAS is to the right of short-run equilibrium.

How economy adjusts from recessionary gap to long-run equilibrium:

Price decreases due to overproduction = inflation rate $\pi \downarrow$ = SRAS down; Fed lower interest rate $r \downarrow$ = AD to the right = $Y \uparrow$

e.g. If LRAS: $Y^* = 5000$, SRAS: $\pi = 0.05$, AD: $Y = 5200 - 10000\pi$

Short run equilibrium (intersection of AD and SRAS): $Y = 4700, \pi = 0.05$

Long run equilibrium (intersection of AD and LRAS): $Y^* = 5000, \pi^* = 0.02$

Only if the adjustment process is slow, fiscal and monetary policies can be used to stabilize the economy. The speed of adjustment depends on the use of long-term contracts and the efficiency and flexibility of the labor market.

Shocks

Inflation shock: a sudden and unexpected change in the inflation rate.

Assume current economy is at $A(Y^*, \pi)$. If inflation rate suddenly increases to π', SRAS shifts up and intersects AD at $B(Y', \pi')$ where $Y' < Y^*$ and $\pi' > \pi^*$.

If no policy response, the economy will self-correct to $A(Y^*, \pi)$ in the long run.

If policy intervenes, the Fed shifts AD to the right (increases money supply), the economy will self-correct to $C(Y^*, \pi')$ in the long run. i.e. the base inflation rate has increased.

Aggregate supply shock: a sudden and unexpected change in the productive capacity of the economy.

Assume current economy is at $A(Y^*, \pi)$. If the productive capacity of the economy suddenly decreases to Y', LRAS shifts left and intersects AD at $B(Y', \pi')$ where $Y' < Y^*$ and $\pi' > \pi^*$. This is the new long-run equilibrium.

Recovering from stagflation. Assume current economy is at $A(Y^*, \pi)$. The inflation rate is high $\pi > \pi^*$.

Federal shifts AD to the left, the short-run equilibrium is at $B(Y', \pi)$ where $Y' < Y^*$, which creates a recessionary gap. The economy will self-correct to $C(Y^*, \pi)$ in the long run. The potential output (LRAS) is unchanged, but the inflation rate (SRAS) has decreased.

Open economy

Exchange rates

Below we assume the domestic currency is USD and the foreign currency is EUR.

- **Nominal exchange rate**: the price of one currency in terms of another currency.
- **Appreciation**: an increase in the value of a currency relative to another currency.
- **Depreciation**: a decrease in the value of a currency relative to another currency.
- **Real exchange rate**: the nominal exchange rate adjusted for buying power.

$$\text{RER} = \frac{\text{Price of domestic goods}}{\text{Price of foreign goods}} = \frac{P}{P^f \div e} = \frac{Pe}{P^f}$$

Where P = price of domestic goods (USD), P^f = price of foreign goods (EUR), e = nominal exchange rate (USD/EUR).

If real exchange rate (USD/EUR) is high, buying goods in USD is more expensive than in EUR.

Real and nominal exchange rates are positively related.

Long-run exchange rate

The law of one price: in the long run, identical goods should have the same price in different countries when expressed in a common currency.

Purchasing power parity (PPP): the nominal exchange rate between two currencies is equal to the ratio of the price levels in the two countries.

- PPP doesn't work in the short run; PPP doesn't hold for non-tradable goods (e.g. services).

Short-run exchange rate

- **Foreign exchange market**: the market where currencies are bought and sold.
- **Flexible exchange rate**: the nominal exchange rate is determined by supply and demand in the foreign exchange market.
- **Fixed exchange rate**: the nominal exchange rate is pegged to another currency or a basket of currencies.

[Graph] Supply and demand for USD: X axis: Q = quantity of USD traded; Y axis: e = nominal exchange rate of foreign currency (EUR/USD).

- Supply curve is upward sloping: as USD appreciates, selling USD is more profitable, so the supply of USD increases.
- Demand curve is downward sloping: as USD appreciates, foreign investors are less willing to buy USD, so the demand for USD decreases.
- If $e > e^*$, USD is overvalued, and Fed will sell USD to decrease the exchange rate.
- If $e < e^*$, USD is undervalued, and Fed will buy USD to increase the exchange rate.

Supply of USD is determined by:

- the preference for foreign goods and services (imports). Higher imports = higher supply of USD.
- US real GDP. Higher GDP = higher supply of USD.
- Real interest rate on European assets r^f and US assets r. $r^f > r$ = selling USD to invest in EUR is profitable = higher supply of USD.

Example: higher imports = higher supply of USD = supply shifts to the right = USD depreciates $e' < e^*$, the quantity of USD traded increases $Q' > Q^*$.

Demand for USD is determined by:

- the preference for US goods and services.
- European real GDP.
- Real interest rate on US assets r and European assets r^f.

Example: Fed increases interest rate $r \uparrow$ = higher demand for USD = demand shifts to the right = USD appreciates $e' > e^*$, the quantity of USD traded increases $Q' > Q^*$.

Momentary policy is more effective in an open economy with flexible exchange rates.

Example: Fed tightens monetary policy $r \uparrow$. Domestically, $r \uparrow$ = induced spending $C + I^P \downarrow$ = $\mathrm{PAE} \downarrow$ = $Y \downarrow$. Internationally, $r \uparrow$ = higher demand for USD = USD appreciates $e \uparrow$ = US goods are more expensive = exports decrease and imports increase = $NX \downarrow$ = $Y \downarrow$.

Fixed exchange rate

Fixed exchange rates greatly reduce the effectiveness of monetary policy. The central bank must maintain the fixed exchange rate by buying and selling foreign currency.

Benefits of fixed exchange rates: reduce uncertainty in international trade, increase predictability and stability in foreign transactions.

International reserves: the foreign currency held by the central bank to maintain the fixed exchange rate. If the central bank runs out of reserves, it cannot maintain the fixed exchange rate.

- A balance-of-payments deficit = a net decline in international reserves over a year = central bank sells more foreign currency than it buys.
- A balance-of-payments surplus = a net increase in international reserves over a year = central bank buys more foreign currency than it sells.

Speculative attack: a sudden and massive sell-off of a currency in anticipation of a devaluation. Since the supply of local currency suddenly increases, the value of the currency decreases, and the new equilibrium will be at $e' < e^*, Q' > Q^*$. Happens when investors believe the currency is overvalued and will be devalued in the future.

Migration: raise interest rate r to attract foreign investment = higher demand for local currency = higher nominal exchange rate e. Also reduce the supply of local currency.

The Euro: a common currency used by most of the European Union. The European Central Bank (ECB) is responsible for monetary policy in the Eurozone.