What will we cover next?

Economic Environment:
- Population
- Technology
- Capital Stock
- Human Capital Stock

Long Run Equilibrium

Short Run Equilibrium

Financial Assets Markets
(Money, Bonds)

Aggregate Demand (AD)

Aggregate Supply (AS)

Medium Run Equilibrium

Final Goods Markets

Production Factors Markets
(Labour Market, Land Market, etc.)

How does this work?

Foreign Markets
(net exports, net foreign investment)
What happens when an economy becomes open?

1. You **trade** → Openness in **goods markets**
2. You **invest** → Openness in **financial markets**
3. You **migrate** → Openness in **labour markets**

We will restrict ourselves to the first two markets
⇒ Open economy model in interest rates & output

How does being open change things?

UK and USA are open and foreign exchange happens in London:

1. If we want to buy imports we need $ → USA firms don’t take £
2. If we want to sell exports to USA we get $ → They exchange $ for £ and buy from our firms
3. If we want to invest in the USA we need $ → USA bonds are issued in $
4. If we want to use USA capital here we get $ → USA investors exchange $ for £ and buy our bonds

We keep track of $ transactions with USA in BOP account
The Balance of Payments

What is the Balance of Payments Account?
→ BOP account summarises a country’s transactions with the rest of world

- The Current Account (CA)
  → Goods market transactions go in current account
  → Essentially CA measures \( NX = \text{Exports} - \text{Imports} \)

- The Capital Account (CF)
  → Financial market transactions go in capital account
  → Essentially CF measures \( NFI = \text{Outward FI} - \text{Inward FI} \)

BOP account must always balance!
→ CA balance is always opposite to CF balance
CA surplus = CF deficit or CA deficit = CF surplus

Balance of Payments equilibrium

BOP equilibrium is our central condition for an open economy:

\[
BOP = NX - NFI = 0 \quad \rightarrow \quad NX = NFI
\]  

(1)

How do we know BOP equilibrium will be achieved?

- Supply & Demand! \( \Rightarrow \) either price or quantity must adjust!

How is BOP equilibrium achieved? \( \rightarrow \) Depends on exchange rate regime!

- If there is a fixed exchange BOP equilibrium will always be restored in balance sheet of CB \( \rightarrow \Delta \) money supply (quantity of $)

- If there is a floating exchange then BOP equilibrium will be restored by \( \Delta \) exchange rate (price of $)
Getting to BOP equilibrium: The Exchange Rate

We can obtain $e^*$ from the supply & demand for foreign currency

\[
\text{Supply} = \text{Demand} = \text{Supply} = S(X, \text{inwardFl}, e) + + \quad (2)
\]

\[
\text{Demand} = D(IM, \text{outwardFl}, e) = + - \quad (3)
\]

\[
e = \text{exchange rate (} \frac{\text{£}}{\$} \text{)} = e \quad (5)
\]

⇒ Supply of foreign currency is the result of foreign demand for domestic exports & foreign demand for domestic investment opportunities (domestic interest rates)

⇒ Demand for foreign currency is the result of domestic demand for foreign imports & domestic demand for foreign investment opportunities (foreign interest rates)

Floating Exchange Rate Equilibrium

Excess supply means price of $ must fall

Under floating exchange rates excess supply of $ appreciates the pound
What is the formal model for the BP curve?

\[ BOP = NX - NFI = 0 \] (6)

We need to start by considering the NX function

\[ NX = X - e(IM) \] (7)
\[ X = X(Y^s, e) \] (8)
\[ IM = IM(Y, e) \] (9)

We can write the net export function as:

\[ NX = X - e(IM) \]
\[ + - + - \]
\[ NX = NX(Y^s, Y, e) \] (10)
Visualising the Net Export Function

We must have balanced trade when \( NX = 0 \)

\[ \text{NX function shows that an increase in income increases imports and lowers net exports} \]

\[ \begin{align*}
\text{Net Exports (NX)} \\
\text{Income (Y)} \\
\text{NX(Y)}
\end{align*} \]

Dynamics of the Net Export Function

Consider the Net Export Function:

\[ \quad \text{We will shift the NX function upward if:} \]

- Increase in foreign income
- Increase in the marginal propensity to import of foreigners
- Increase in the sensitivity of exports or imports to the exchange rate

\[ \begin{align*}
\text{NX} &= \text{NX}(Y^S, Y, e) \\
(11)
\end{align*} \]

\[ \quad \text{We will flatten the slope of the NX function if:} \]

- Decrease in the marginal propensity to import of domestic residents

\[ \begin{align*}
\text{Notes}
\end{align*} \]
**NX Dynamics: An Exogenous Shift**

Notice that a change in the exchange rate will also shift the NX function!
- However we don’t know if $\uparrow e \Rightarrow \uparrow NX$
- If we depreciate $\rightarrow$ immediate price effect and delayed quantity effect
- If exports & imports are price inelastic then price effect will dominate
- This is equivalent to: $\downarrow NX = (\uparrow X) - [\uparrow e (\downarrow IM)]$
- $\uparrow e \Rightarrow \uparrow NX$ will only be true if the Marshall-Lerner Condition holds

Marshall-Lerner condition is:

$$|\text{price elasticity of exports}| + |\text{price elasticity of imports}| > 1 \quad (12)$$
Returning to our full model: What determines NFI?

Now we need to understand what determines the NFI function:

\[
NFI = NFI(i^*, i) = h(i^* - i)
\]

(13)

where \(0 \leq h \leq \infty\) represents the measure of capital mobility

- If \(h = 0\) then zero capital mobility \(NFI = 0\)
- If \(h = \infty\) then perfect capital mobility \(i = i^*\)

What does this mean?

- Investors seek out the highest interest rate either at home or abroad
- If domestic interest rates exceed foreign rates (assuming capital has any mobility) then foreigners buy domestic bonds
- The more capital mobility the easier it will be for investors to take advantage of interest differentials
- The NFI function does not depend on income (Y)
The BP curve

Now we know what determines the components of BOP equilibrium:

\[ NX = NX(Y^S, Y, e) \]
\[ NFI = NFI(i^S, i) \]  

(14)

(15)

We can solve for the BP curve given our definitions of NX & NFI:

\[ BOP = NX - NFI = 0 \rightarrow NX(Y^S, Y, e) = NFI(i^S, i) \]  

(16)

(17)

We can solve this for interest rates as function of income:

**BP curve:** \[ i = f(i^S, Y^S, e, Y) \]  

(18)

Visualising the BP curve

We have an equation for the BP curve in terms of \( i \) & \( Y \)

\[ i = i(i^S, Y^S, e, Y) \]  

(19)

This is exactly what we wanted as the addition to our IS-LM model

What can we say about BP curve?

- BP curve has a positive slope relating \( i \) to \( Y \)
  - Higher \( Y \) means more IM requiring higher \( i \) for BOP equilibrium
- When \( Y = Y_{BT} \) then we must have \( i = i^S \)
  - Inward FI must also match outward FI
- Points above and left of BP curve represent BOP surpluses
  - BOP surplus is associated with high \( i \) attracting foreign \( \$ \)
- Points below and right of BP curve represent BOP deficits
  - BOP deficit is associated with low \( i \) causing flight of domestic \( \£ \)
Visualising the BP curve

**The BP Curve: mapping out $i$ & $Y$ given BOP**

We need a higher $i$ in order to stay on our BP curve given a higher $Y$.

At higher levels of $Y$ with same $i$ there will be a BOP deficit.
Dynamics of the BP curve

The BP curve will shift right if:

- There is a depreciation of the currency ($\uparrow e$)  
  → assuming Marshall-Lerner holds so $\uparrow e \rightarrow \uparrow Y_{BT}$
- There is an exogenous increase in $Y^d$, MPI of foreigners, sensitivity of exports or imports to $e$  
  → These were all the factors that shifted up NX function ($\uparrow Y_{BT}$)

The slope of the BP curve will flatten if:

- There is an increase of capital mobility ($\uparrow h$)
- There is a decrease in the MPI of domestic citizens

We should also consider a couple special cases

- Zero capital mobility → BP curve will be vertical with $Y = Y_{BT}$
- Perfect capital mobility → BP curve will be horizontal with $i = i^d$

Dynamics of BP curve: a depreciation

Depreciation shifts the BP curve right implying BOP eqm at a higher $Y$ for every value of $i$
The BP curve: $h = 0$

Capital is perfectly immobile so investors cannot transfer capital and we must always have balanced trade since exports must always be matched by imports as this is the only way to exchange.

The BP curve: $h = \infty$

Capital is perfectly mobile so the interest rate ($i$) is always at the world interest rate.
Open Economy IS
Our final addition to the model is to develop an open economy IS curve
→ The LM curve is exactly the same when open or closed!

Recall our equations for demand (Z)
→ We obtain open economy IS curve by adding NX to closed economy:

\[ C = C(Y, T) \quad (20) \]

\[ I = I(Y, i) \quad (21) \]

\[ NX = NX(Y^*, Y, e) \quad (22) \]

Now we can solve for goods market equilibrium:

\[ Y = Z \Rightarrow Y = C(Y, T) + I(Y, i) + G + NX(Y^*, Y, e) \quad (23) \]

Characteristics of Open Economy IS

\[ Y = Y(i, G, T, Y^*, e) \Rightarrow i = i(Y, G, T, Y^*, e) \]

We can observe the following:

- We still have a negative relationship between \( Y \) and \( i \)
- The fiscal multiplier is still dependent on the marginal propensity to consume and marginal propensity to invest
- Assuming interest rates are not fixed or independent of investment there will be some crowding out
- The fiscal multiplier has been reduced in the open economy!
  → We will now have a smaller change in \( Y \) for a given change in \( G \)
  → Increase in \( Y \) will cause imports to increase and dampen \( G \)
  → This is a crowding out effect of imports rather than interest rates!
The IS-LM-BP Model

Now we have arrived at our open economy model → IS-LM-BP

IS curve: \[ i = i(Y, G, T, Y^S, e) \] (24)

LM curve: \[ i = i\left(\frac{M}{P}, Y\right) \] (25)

BP curve: \[ i = i(i^S, Y^S, e, Y) \] (26)

How is IS-LM-BP equilibrium achieved?

- Under fixed exchange rates the endogenous variables are \( Y, i, M \)
  \( \rightarrow e \) is fixed & CB must buy/sell foreign $ causing \( \Delta \) in \( M \)
  \( \rightarrow \) Hence the LM curve will move to achieve equilibrium
- Under floating exchange rates the endogenous variables are \( Y, i, e \)
  \( \rightarrow e \) is floating and NX will adjust with \( e \) to clear markets
  \( \rightarrow \) Hence both IS curve and BP curve will move to achieve equilibrium

Visualising IS-LM-BP

[Diagram showing IS, LM, and BP curves with IS-LM-BP equilibrium at \( Y_{BT} \) and \( i^S \).]
Capital Mobility in IS-LM-BP

A key issue for equilibrium will be **degree of capital mobility**

→ Previous figure was drawn for a particular degree of mobility

What does the degree of capital mobility imply for IS-LM-BP?
- capital is perfectly immobile if BP is vertical (BP slope = ∞)
- capital is relatively immobile if BP is steeper (LM slope < BP slope)
- capital is relatively mobile if BP is flatter (LM slope > BP slope)
- capital is perfectly mobile if BP is horizontal (BP slope = 0)

Mobility of capital is very important! → Why?
→ In order to understand we need to explain the dynamics of equilibrium!
→ Adjustment to equilibrium will depend on the degree of capital mobility
→ Consider what happens when we shift the LM curve (monetary policy) or the IS curve (fiscal policy)

Monetary expansion under fixed e

\[
(\uparrow M) \rightarrow \downarrow i = i(\frac{\uparrow M}{P}, Y) \rightarrow \uparrow Y = Y(\downarrow i, G, T, Y^S, e)
\]

BOP deficit \( \Delta NX < 0 \neq \Delta NFI > 0 \)

\[
(\downarrow M) \rightarrow \uparrow i = i(\frac{\downarrow M}{P}, Y) \rightarrow \downarrow Y = Y(\uparrow i, G, T, Y^S, e)
\]

What happens when the CB expands the money supply \( \uparrow M \)
- We shift LM curve right creating a **BOP deficit** → why?
- We get higher output and lower domestic interest rates
- This means we increase imports and investors seek foreign assets
- This forces the CB to sell foreign $ \rightarrow$ satisfy demand for foreign $ with greater supply $ to maintain fixed $e
- **Without sterilisation** this lowers CB reserves \( \downarrow M \) shift left LM

⇒ Monetary policy is ineffective under fixed exchange with capital mobility
The Macro-Trilemma

Consider the situation where there is perfectly mobile capital

→ Any fall in interest rates will cause complete outflow of capital

→ In this case we always have \( i = i^S \)

- If the CB increases \( M \) this will shift LM right creating a CA deficit
- CB will be forced to sell $ shifting LM left removing CA deficit
- In previous case CB could counter this with sterilisation
- This means CB can buy domestic bonds whilst it sells foreign $
- If capital is perfectly mobile this will be impossible since \( i = i^S \)
- CB cannot hold the interest rate below the world rate and accommodate the CA deficit due to pressure on \( i \)

⇒ This is the Macroeconomic trilemma! → choose 2 of 3 (fixed e, monetary policy & free capital flows)
Fiscal expansion under fixed e & relatively immobile capital

\[(\uparrow G) \rightarrow \uparrow Y = Y(i, \uparrow G, T, Y^S, e) \rightarrow \uparrow i = i\left(\frac{M}{P}, \uparrow Y\right)\]

BOP deficit \(\rightarrow \Delta NX > \Delta NFI\)

\[(\downarrow M) \rightarrow \uparrow i = i\left(\frac{M}{P}, Y\right) \rightarrow \downarrow Y = Y(\uparrow i, G, T, Y^S, e)\]

What happens when the Government spends \(\uparrow G\)?
- We shift IS curve right creating a **BOP deficit** → why?
- We get higher output and higher domestic \(i\) but not high enough \(i\)
- We increase imports and investors seek domestic assets but the demand for imports is stronger effect
- This forces the CB to sell foreign $ → satisfy excess demand for foreign $ with greater supply $ to maintain fixed e
- **Without sterilisation** this lowers CB reserves → \(\downarrow M\) shift left LM

⇒ Fiscal policy is somewhat effective when open but less than closed
Fiscal expansion under fixed $e$ & relatively mobile capital

\[(\uparrow G) \rightarrow \uparrow Y = Y(i, \uparrow G, T, Y^S, e) \rightarrow \uparrow i = i\left(\frac{M}{P}, \uparrow Y\right)\]

BOP surplus \[\rightarrow \Delta NX < \Delta NFI\]

\[(\uparrow M) \rightarrow \downarrow i = i(\frac{M}{P}, Y) \rightarrow \uparrow Y = Y(\downarrow i, G, T, Y^S, e)\]

What happens when the Government spends \(\uparrow G\)?
- We shift IS curve right creating a BOP surplus → why?
- We get higher output and higher domestic \(i\) but too high \(i\)
- This means we increase imports and foreign investors seek domestic assets but the inward FI is stronger effect
- This forces the CB to buy foreign $ → satisfy excess supply of foreign $ with greater demand for $ to maintain fixed $e$
- Without sterilisation this raises CB reserves → \(\uparrow M\) shift right LM

⇒ Fiscal policy is highly effective when open relative to closed
A devaluation under fixed $e$

\[ (\uparrow e) \rightarrow \uparrow Y = Y(i, G, T, Y^s, \uparrow e) \rightarrow \uparrow i = i\left(\frac{M}{P}, \uparrow Y\right) \]

BOP surplus $\rightarrow \Delta NX < \Delta NFI \rightarrow (\uparrow e) \rightarrow \uparrow Y_{BT}$

\[ (\uparrow M) \rightarrow \downarrow i = i\left(\frac{M}{P}, Y\right) \rightarrow \uparrow Y = Y(\downarrow i, G, T, Y^s, e) \]

What happens when the Government devalues $\uparrow e$?

- We shift IS and BP curves right creating a **BOP surplus** $\rightarrow$ why?
- We get higher output and interest rate (IS shift) but a much higher $Y_{BT}$ (BP shift) leaving massive CA surplus
- This forces the CB to buy foreign $ to satisfy excess supply of foreign $ with greater demand for $ to achieve new fixed $e$
- This raises CB reserves $\rightarrow \uparrow M$ shift right LM

$\Rightarrow$ Devaluation is highly effective open economy policy
A special case for devaluation

Consider the situation where there is perfectly immobile capital
→ No foreign borrowing or lending is possible so current account must balance → In this case we always have $Y = Y_{BT}$

- If the CB increases $M$ this will shift LM right creating a CA deficit
  → CB will be forced to sell $\$ shifting LM left removing CA deficit
- If the Gov increases $G$ this will shift IS right creating a CA deficit
  → CB will be forced to sell $\$ shifting LM left removing CA deficit
- If the Gov devalues this will shift IS & BP right creating CA surplus
  → CB will be forced to buy $\$ shifting LM right removing CA deficit

⇒ Only the devaluation will have any effect on output!

An increase in $G$ with perfectly immobile capital

With perfectly immobile capital only a shift in BP right caused by a devaluation can increase output

Increase in $G$ causes a BOP deficit and CB will have to sell foreign $\$ lowering M
Monetary expansion under floating $e$

$$(\uparrow M) \rightarrow \downarrow i = i(\frac{M}{P}, Y) \rightarrow \uparrow Y = Y(\downarrow i, G, T, Y^S, e)$$

BOP deficit $\rightarrow \; \Delta NX < 0 \neq \Delta NFI > 0 \rightarrow (\uparrow e) \rightarrow \uparrow Y_{BT}$$

$$(\uparrow e) \rightarrow \uparrow Y = Y(i, G, T, Y^S, \uparrow e) \rightarrow \uparrow i = i(\frac{M}{P}, \uparrow Y)$$

What happens when the CB expands the money supply $\uparrow M$?

- We shift LM curve right creating a **BOP deficit** $\rightarrow$ why?
- We get higher output and lower domestic interest rates
- This means we increase imports and investors seek foreign assets
- Excess demand for foreign $ causes a depreciation $\uparrow NX \& \downarrow Y_{BT}$
- This means IS & BP curves shift right

$\Rightarrow$ Monetary policy is highly effective with floating exchange rates
Fiscal policy under floating $e$ & relatively immobile capital

\[(\uparrow G) \rightarrow \uparrow Y = Y(i, \uparrow G, T, Y^s, e) \rightarrow \uparrow i = i\left(\frac{M}{P}, \uparrow Y\right)\]

BOP deficit $\rightarrow \Delta NX > \Delta NFI$ $\rightarrow (\uparrow e) \rightarrow \uparrow Y_{BT}$

\[(\uparrow e) \rightarrow \uparrow Y = Y(i, G, T, Y^s, \uparrow e) \rightarrow \uparrow i = i\left(\frac{M}{P}, \uparrow Y\right)\]

What happens when the Government spends $\uparrow G$?

- We shift IS curve right creating a BOP deficit $\rightarrow$ why?
- We get higher output and higher domestic $i$ but not high enough $i$
- We increase imports and investors seek domestic assets but the demand for foreign $\$ is stronger effect
- Excess demand for foreign $\$ causes a depreciation $\uparrow NX & \downarrow Y_{BT}$
- This means IS & BP curves shift right

$\Rightarrow$ Fiscal policy is highly effective when open even relative to closed

Notes

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Fiscal policy under floating $e$ & relatively immobile capital

![Diagram showing IS and BP curves, and how changes in government spending affect interest rates and output](image-url)
Fiscal expansion under floating e & relatively mobile capital

\[(\uparrow G) \to \uparrow Y = Y(i, \uparrow G, T, Y^S, e) \to \uparrow i = i\left(\frac{M}{P}, \uparrow Y\right)\]

BOP surplus \(\to \Delta NX < \Delta NFI \to \downarrow e \to \downarrow Y_{BT}\)

\[(\downarrow e) \to \downarrow Y = Y(i, G, T, Y^S, \downarrow e) \to \downarrow i = i\left(\frac{M}{P}, \downarrow Y\right)\]

What happens when the Government spends \(\uparrow G\)?

- We shift IS curve right creating a BOP surplus \(\to \text{why?}\)
- We get higher output and higher domestic \(i\) but too high \(i\)
- This means we increase imports and foreign investors seek domestic assets but the supply of foreign $ is stronger effect
- Excess supply of foreign $ causes an appreciation \(\downarrow NX \& \uparrow Y_{BT}\)
- This means IS & BP curves shift left

\(\Rightarrow\) Fiscal policy somewhat effective when open but less than closed
A special case for monetary policy

Consider the situation where there is perfectly mobile capital

→ Any fall in interest rates will cause complete outflow of capital
→ In this case we always have $i = i^*$

- If government increases $G$ this will shift IS right creating a CA deficit
- This will cause an appreciation and interest rates will stay fixed
- Given BP curve is horizontal the IS curve must shift entirely back to achieve equilibrium
- This means the appreciation has completely crowded out increase in $G$ by lowering NX!
- If capital is perfectly mobile then fiscal policy will be useless

This is the **Mundell-Fleming model** ⇒ Where only monetary policy can have an effect on output due to perfect capital mobility

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An increase in $G$ with perfectly mobile capital

![Diagram](image)
A few points

We have ignored the real exchange rate!

- The real exchange rate is given by $RER = e^{P^s/P}$
- We considered the open economy in SR so prices were fixed
- This meant we did little harm to assume $P^s = P$
- Therefore by our assumptions we had $RER = e$
- In the LR we will actually have $RER = 1$ where $e$ will set prices to be equal across countries $→$ This is PPP and the law of one price!

A few points

We have ignored the size of countries!

- Small open economies and large open economies are different
- Large economies can influence foreign interest rates and output
- Small open economies take foreign interest rates & output as given
- Hence we assumed a small economy model where foreign interest rates and GDP are exogenous
A few more points

We have ignored country interactions!
- If countries have fixed exchange rates then domestic devaluation implies foreign revaluation
  → Would foreign countries simply accept our devaluation?
- If countries have floating exchange rates then monetary expansion causes competitive depreciation
  → Would foreign countries simply accept our depreciation?
- There is a lot of game theory here!
  → Again size & power of countries matters!

We have been working in the SR with fixed prices
- What if a depreciation involves higher prices and lower real wages?
- Depreciation impacts the PRW curve and our natural level of output!
- There is no consensus AS-AD macro model for open economy
- This is obviously massively complex (many countries not just two, some big some small, some fixed some floating, various CB approaches, etc...)