

Macroeconomics

Lecture 4 – Open Economy: IS-TR-IFM, AD-AS

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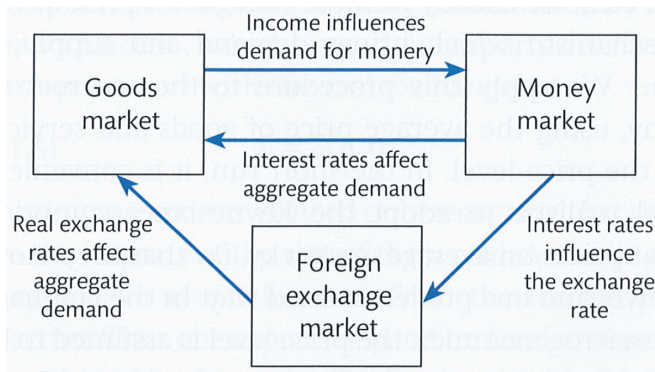
PSME Panthéon-Sorbonne Master in Economics

Fall 2022

Overview

- 1 Exchange rates
- 2 IS in open economy
- 3 Capital flows: IFM line
- 4 Fixed exchange rate regime
 - IS-(TR)-IFM equilibrium
 - AD-AS
- 5 Flexible exchange rate regime
 - (IS)-TR-IFM equilibrium
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- 6 More on exchange rate regimes

Open economy: new market(s)



Source. Burda and Wyplosz (2017), Figure 10.2.

Lecture overview: opening up IS-TR and AD-AS

1. Goods market has imports and exports \Rightarrow IS equation has new terms
 - ▷ **Exchange rate** movements **shift** IS
2. International financial markets influence nominal interest rate
 - \Rightarrow **IFM line**
 - ▷ IS-TR-IFM or Mundell-Flemming model
3. Medium run (AD-AS): inflation affects **real exchange rate**
4. Long run: **purchasing power parity** affects inflation and exchange rate

Distinction between **fixed** and **flexible** exchange rate regimes.

AS is same as in closed economy (simplification).

Exchange rates – quick overview

Nominal vs. **real** exchange rates:

- ▶ **Nominal** exchange rate – number of units of one currency per unit of another \Leftrightarrow **relative price of monies**
 - ▶ Can be expressed in units of foreign currency per unit of domestic or vice versa
 - ▶ Example: EUR-JPY exchange rate is 140 JPY for 1 EUR
- ▶ **Real** exchange rate (RER) - ratio of foreign consumption basket value to domestic consumption basket value \Leftrightarrow **relative price of consumption**

Using S as **nominal** exchange rate (number of units of foreign currency per unit of domestic), P the domestic and P^* the foreign price level, define the **real** exchange rate σ as:

$$\sigma = \frac{S \cdot P}{P^*}$$

RER dynamics formula

Taking logs and total differential in the real exchange rate definition:

$$\frac{d\sigma}{\sigma} = \frac{dS}{S} + \frac{dP}{P} - \frac{dP^*}{P^*}$$

$$\frac{d\sigma}{\sigma} = \frac{dS}{S} + \pi - \pi^*$$

Long run real exchange rate

Absence of **arbitrage** between countries assumed in long run \Rightarrow two versions of **purchasing power parity (PPP)** condition:

1. **Absolute PPP**: $\sigma = 1 \Leftrightarrow S \cdot P = P^*$
2. **Relative PPP**: σ constant:

$$d\sigma = 0 \Rightarrow \frac{d\sigma}{\sigma} = \frac{dS}{S} + \frac{dP}{P} - \frac{dP^*}{P^*} = 0$$

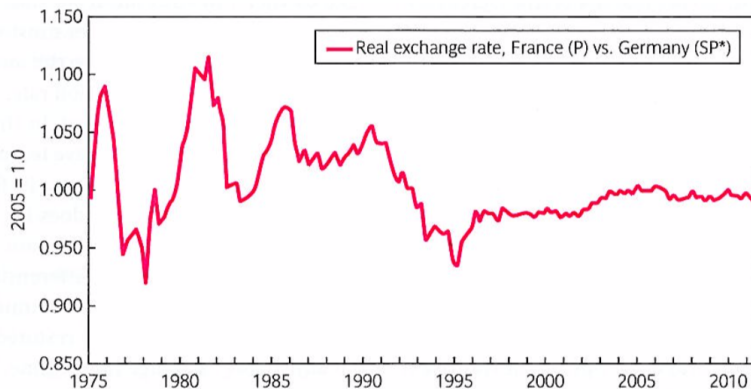
$$\frac{dS}{S} = \pi^* - \pi$$

\Rightarrow if domestic and foreign inflation rates not equal on average, permanent nominal exchange rate appreciation/depreciation

Micro version of PPP – **law of one price**: each good j has same price in domestic and foreign economy: $S \cdot p_j = p_j^*$

Sufficient, but **not necessary** for PPP to hold.

Real exchange rate: Example



Source. Burda and Wyplosz (2017), Figure 13.9.

IS curve in open economy

IS obtained from equality of total goods available (left hand side) and all the uses of the goods (right hand side):

$$Y + \underbrace{Z}_{\text{imports}} = C + I + G + \underbrace{X}_{\text{exports}}$$

Re-arranging, we get:

$$Y = C + I + G + \underbrace{(X - Z)}_{\text{primary current account (PCA)}}$$

Primary current account

Import function

$$Z = Z(Y_+, \sigma_+) \quad (11.5)$$

- ▶ Increases in income (proportional to disposable income or to consumption), example: $Z = z \cdot C = z \cdot c \cdot (Y - T)$
- ▶ Increases with real exchange rate appreciation ($\sigma \uparrow$, where $\sigma = SP/P^*$), domestic goods relatively expensive \Rightarrow import \uparrow

Export function

$$X = X(Y_+^*, \sigma_-) \quad (11.6)$$

- ▶ **demand-driven exports:** foreign income \Rightarrow foreign demand. Domestic income/production not relevant!
- ▶ with real exchange rate appreciation ($\sigma \uparrow$), domestic goods relatively expensive \Rightarrow less exports

Primary Current Account (PCA) or Net Exports:

$$\begin{aligned} PCA &= X(Y_+^*, \sigma_-) - Z(Y_+, \sigma_+) \\ &= PCA(Y_-, Y_+^*, \sigma) \end{aligned}$$

Keynesian multiplier in open economy

Assume linear functions: $C = c \cdot (Y - T)$

$$Z = z \cdot C = z \cdot c \cdot (Y - T)$$

Consider an increase in government expenditure, ΔG

- ▷ $DD \uparrow$, firms will produce more, ..., $Y \uparrow$
 - ▷ **Multiplier**: how much output changes ΔY , relative to shock ΔG
 - ▷ firms will increase production by ΔG
 - ▷ this generates new income, thus $C \uparrow$ but $PCA \downarrow$,
 $\Delta DD = c\Delta G - zc\Delta G = c(1 - z)\Delta G$
- $Y \uparrow, C \uparrow, PCA \uparrow, Y \uparrow \dots$ – recall staircase graph
- ▷ additional spending $\Delta C + \Delta PCA$ is smaller than ΔG due to *leakages*, so $\Delta Y_2 < \Delta Y_1$
 - ▷ leakages in open economy: savings, **imports**, taxes (if proportional)

$$\Delta Y = \Delta G + c(1 - z)\Delta G + c^2(1 - z)^2\Delta G + \dots + c^n(1 - z)^n\Delta G$$

$$= \underbrace{\frac{1}{1 - c(1 - z)}}_{\text{multiplier} > 1} \Delta G$$

Open economy IS

Key question: how change of real exchange rate σ affect IS?

- ▷ RER appreciation \Rightarrow more imports, less exports \Rightarrow for a given interest rate, goods market equilibrium has lower Y because of lower aggregate demand

$$Y = C(\Omega, Y - T) + I(r, q) + G + PCA(Y, Y^*, \sigma)$$

$$\underbrace{Y - C(\Omega, Y - T) - PCA(Y, Y^*, \sigma)}_{\text{increases in } Y, \sigma} = I(i - \pi^e, q) + G$$

- ▷ Mathematics: left hand side increasing in both Y and $\sigma \Rightarrow$ for a fixed right hand side, $Y \downarrow$ when $\sigma \uparrow$ for equation to hold

\Rightarrow when $\sigma \uparrow$, $Y \downarrow$ for fixed $i \Rightarrow$ **IS moves left** in (Y, i) space.

What are capital flows?

This lecture: wider notion of capital, including any assets + currency.

Any purchase/sale of foreign assets is registered in country's international capital flows. Examples:

- ▶ Use of foreign currency
- ▶ Lending/borrowing with non-resident
- ▶ Foreign direct investment

Policy of capital movement restriction: **capital controls**

- ▶ Goes against orthodox economic theory/finance, but...
- ▶ Actively used by China \Rightarrow relevant for understanding world economy
- ▶ **Not studied** in this lecture

International financial market: capital flows

We adopt assumption of **small open economy** with free capital flows (no **capital controls**):

- ▶ Recall small open economy definition: country does not influence international prices
- ▶ ... in particular, international nominal interest, i^*
- ▶ free capital flows \Rightarrow no **arbitrage** possibilities between domestic and foreign assets, **returns are equalized**: $i = i^*$

\Rightarrow a new condition in the (Y, i) space: a horizontal IFM line

Economy off IFM line – exchange rate regime matters

What happens after capital inflows/outflows? What consequences for IS, TR \Rightarrow for AD?

\rightarrow answers depend on **exchange rate regime**

- ▶ Under **fixed exchange rate regime**, CB must prevent changes in **nominal exchange rate**
 - ▶ Taylor Rule, money supply change such that $i = i^*$ again
- ▶ Under **flexible exchange rate regime**, CB does not react, nominal exchange rate changes, IS shifts
 - ▶ Additional stability of IS following demand shocks

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Fixed exchange rate in IS-TR

- ▶ Open economy \Rightarrow loss of monetary autonomy because of capital flows: $i = i^*$
- ▶ Choice of money supply by the CB dictated by exchange rate
- ▶ Taylor Rule is no longer determining equilibrium
- ▶ The horizontal IFM line in (i, Y) space determines equilibrium instead of TR

We will consider different types of shocks in this IS-(TR)-IFM framework.

Demand shock (e.g. government spending)

Devaluations/revaluations – monetary policy via \bar{S}

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- ▶ IS moves as explored before
- ▶ Central bank must adapt monetary policy – TR shifts
- ▶ Behind the scenes – central bank buys or sells foreign currency to keep S fixed – **foreign exchange interventions**
- ▶ Change of CB **assets** must be coupled with changes of **liabilities** – the money supply
- ▶ Process known as **sterilisation** of foreign exchange interventions

International financial shock – shift of IFM

An increase in world
interest rate is
contractionary for fixed
exchange rate
economies

Relevant shock for
2022!

LAD under fixed exchange rates: Purchasing Power Parity

Absence of **arbitrage** between countries assumed in long run \Rightarrow two versions of **purchasing power parity (PPP)** condition:

1. **Absolute PPP**: $\sigma = 1 \Leftrightarrow S \cdot P = P^*$

2. **Relative PPP**: σ constant:

$$d\sigma = 0 \Rightarrow \frac{d\sigma}{\sigma} = \underbrace{\frac{dS}{S}}_{=0} + \pi - \pi^* = 0 \Leftrightarrow \pi = \pi^*$$

Relative PPP follows from absolute, so it is always assumed.

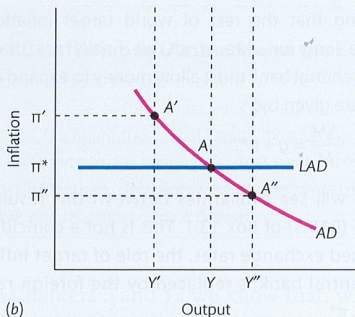
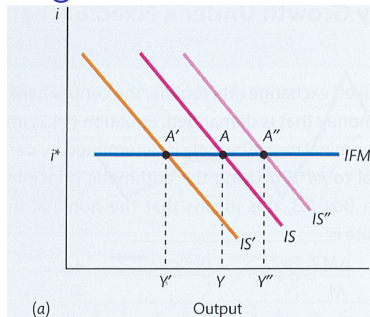
\Rightarrow domestic inflation rate must equal foreign in long run – horizontal long-run aggregate demand line (LAD) at $\pi = \pi^*$

Medium-run AD under fixed exchange rate

- ▶ Assuming $\pi \uparrow$
 - ▶ $\frac{d\sigma}{\sigma} = \frac{dS}{S} + \pi - \pi^* = \pi - \pi^*$
 $\Rightarrow \sigma \uparrow$
 - ▶ IS-(TR)-IFM: IS shifts to the left, intersection with IFM has lower Y
- \Rightarrow inflation higher, output lower: downward sloping medium run *AD* curve

Shifts in AD

- ▶ Demand shocks (incl. Y^*)
- ▶ Devaluations, revaluations (\bar{S})
- ▶ IFM (i^*)



AD-AS with fixed exchange rate regime

New mechanism: long-run convergence of π to π^* through changes of σ .

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Flexible exchange rate

- ▶ Monetary policy is again independent
- ▶ Aggregate demand has additional source of variation: RER changes through **nominal interest rate**
- ▶ Position of IS becomes endogenous as TR and IFM determine equilibrium: (IS)-TR-IFM

Monetary policy shock with flexible exchange rates

Monetary policy *de facto* operates through **exchange rate** and **not interest rate**

Demand shock (e.g. government spending) with flexible exchange rates

Exchange rate acts as **stabilizer** of aggregate demand

International monetary shock

An increase in foreign interest rate is **expansionary** – **opposite** of **fixed** exchange rate case.

International monetary shock II: beggar-thy-neighbour effect

- ▶ Suppose a large foreign economy lowers i^* in expansionary monetary policy
- ▶ What happens to domestic economy? Draw an (IS)-TR-IFM diagram!
- ▶ Domestic i relatively high \Rightarrow capital inflow \Rightarrow real exchange rate appreciation $\sigma \uparrow$
- ▶ IS moves to the left, equilibrium output lower
- ▶ Foreign expansionary policy at the expense of neighbours' output. A critique of expansionary QE policies in large Western economies post-2008, from smaller economies' perspective.

LAD under flexible exchange rate

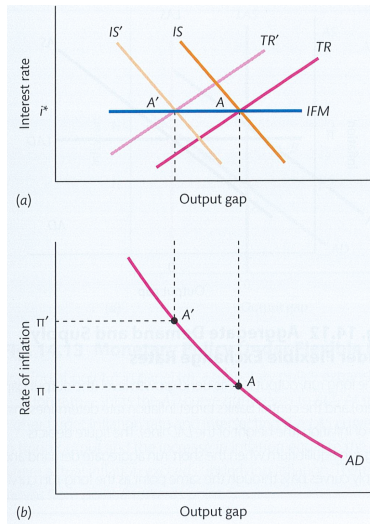
- ▶ LAD: Taylor rule enforces $\pi = \bar{\pi}$ in long run, as in closed economy
- ▶ **Different** from **fixed** exchange rate regime, where LAD is $\pi = \pi^*$

Medium-run AD under flexible exchange rate regime

- ▷ Assuming $\pi \uparrow$
 - ▷ $\frac{d\sigma}{\sigma} = \frac{dS}{S} + \pi - \pi^* \Rightarrow \sigma \uparrow$
 - ▷ IS shifts to the left, TR shifts up – IS-TR-IFM intersection with lower Y
- ⇒ inflation higher, output lower: downward sloping medium run AD curve

Shifts in AD

- ▷ **NOT** the demand shocks (IS shifters other than σ)
- ▷ TR shocks ($\bar{i}, \bar{\pi}$)
- ▷ IFM (i^*) – opposite effect to fixed exchange rate case



Source. Burda and Wyplosz (2017), Figure 14.11.

AD-AS under flexible exchange rate regime

Similar to closed economy, with additional shifts in AD due to σ .

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Recap: trade-offs of exchange rate regimes

Each exchange rate regime presents pros and cons. Seen in this lecture:

- ▷ **Fixed** exchange rate regime:
 - ▷ facilitates trade of goods, services and assets, **but**
 - ▷ eliminates independent monetary policy (control over i)
 - ▷ not necessarily bad, e.g. if CB has **commitment** problems leading to high inflation
- ▷ **Flexible** of floating exchange rate regime:
 - ▷ creates problems in trade, **but**
 - ▷ allows for monetary policy + acts as absorber of demand shocks

Important issues of **foreign exchange reserves** management not covered in lecture – another argument against fixed regimes when CB is not trusted by public.

Beyond fixed vs. flexible: IMF classification

Many regimes exist as countries trade off benefits and costs of fixed and flexible exchange rates.

Type	Categories				
Hard pegs	Exchange arrangement with no separate legal tender	Currency board arrangement			
Soft pegs	Conventional pegged arrangement	Pegged exchange rate within horizontal bands	Stabilized arrangement	Crawling peg	Crawl-like arrangement
Floating regimes (market-determined rates)	Floating	Free floating			
Residual	Other managed arrangement				

Source: IMF Annual report on exchange arrangements and exchange restrictions (2021).