

# Open Economy IS/LM Model: Floating Exchange Rates

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# Equilibrium: Outline

We need to clear

1. the goods market: IS
2. the money market: LM
3. the foreign exchange market: UIP

**Endogenous** variables:  $Y, i, E$

We take as given:

1.  $P$  and  $P^*$  (short run assumption)
2.  $M$ : controlled by the Fed
3.  $E^e$ : the expected future exchange rate

## Equilibrium: Equations

$$IS : Y = C(Y - T) + I(Y, i) + G + \underset{-, +, -}{NX(Y, Y^*, \varepsilon)} \quad (1)$$

$$LM : M/P = YL(i) \quad (2)$$

$$UIP : E = \frac{1 + i^*}{1 + i} E^e \quad (3)$$

with  $\varepsilon = P/EP^*$ .

These solve for  $Y, i, E$ .

Note:  $E$  is in  $\$/\epsilon$ . High  $E$  means weak dollar.

## Digression

What would happen if capital were completely immobile?

## Modified IS Curve

We combine IS and UIP into a new IS curve

- ▶ It clears goods and FX markets

Then we have 2 equilibrium conditions again

The equilibrium graph looks a lot like a closed economy

The main difference:

- ▶ additional variables shift IS ( $Y^*$  and what's in the real exchange rate:  $E, E^e, i^*$ ).

## Modified IS Curve

## Start from IS

$$Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, \varepsilon) \quad (4)$$

Use UIP ( $E = [1 + i^*] / [1 + i] E^e$ ) to substitute out the real exchange rate

$$\varepsilon = P/(EP^*) \quad (5)$$

$$= \frac{1+i}{1+i^*} \frac{1}{E^e} \times \frac{P}{P^*} \quad (6)$$

We can write  $NX\left(Y, Y^*, \frac{1+i}{1+i^*} \frac{1}{E^e}\right)$

- ▶  $i \uparrow$  and  $E^e \downarrow$  lead to dollar appreciation ( $\varepsilon \uparrow$ ) and  $NX \downarrow$
- ▶ prices ( $P/P^*$ ) are omitted arguments (constant here)

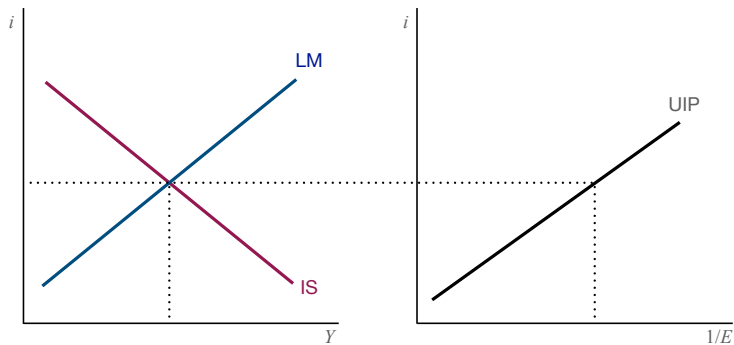
## Modified IS Curve

$$IS : Y + C(Y - T) + I(Y, i) + G + NX \left( Y, Y^*, \frac{1+i}{1+i^*} E^e \right) \quad (7)$$

Properties:

- ▶ downward sloping:  $i \uparrow \implies Y \downarrow$
- ▶ shifters: as closed economy *plus* anything that increases  $NX$

# IS-LM Graph



Higher  $i \implies$  stronger dollar.



# What Has Changed

Relative to a closed economy:

1. the interest rate has an additional effect on IS:

$$i \uparrow \implies E \downarrow \implies NX \downarrow$$

this is driven by capital mobility (UIP)

more mobile capital  $\implies$  flatter IS curve

2. additional shifters of IS:  $i^*, Y^*, E^e$

## Model Summary

$$IS : Y = C(Y - T) + I(Y, i) + G + NX \left( Y, Y^*, \frac{1+i}{1+i^*} \frac{1}{E^e} \right) \quad (8)$$

$$LM : M/P = YL(i) \quad (9)$$

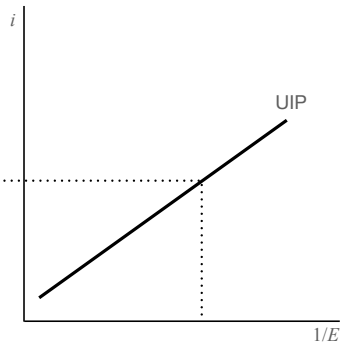
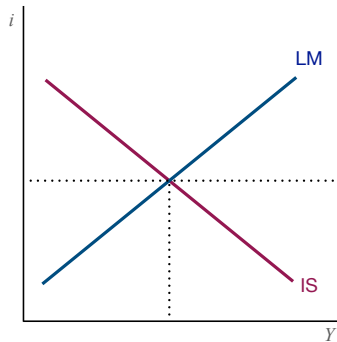
$$UIP : E_{\$/\pounds} = \frac{1+i^*}{1+i} E^e \quad (10)$$

Exogenous:  $P, P^*, Y^*, E^e, G, T$

Endogenous:  $Y, i, E$

# Analyzing Shocks

# Government Spending Rises



# Government Spending Rises

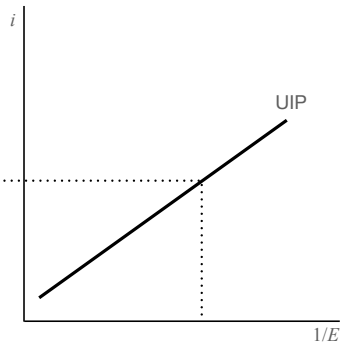
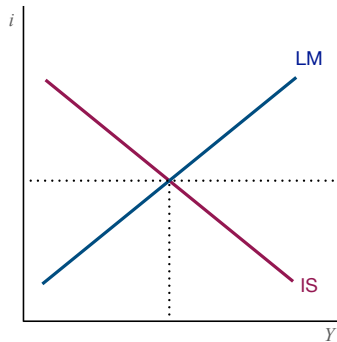
Higher  $G$  leads to:

1. higher  $Y$  and  $i$
2. capital inflows (attracted by higher  $i$ )
3. dollar appreciation ( $E \downarrow$ ) (due to capital inflows)
4. lower  $NX$  (due to higher  $Y$  and lower  $E$ )

Consistency check:  $NX = (Y - T - C) + (T - G) - I$

- $NX \downarrow$  primarily because public saving falls.

# Monetary Contraction



# Monetary Contraction

Lower  $M$  leads to:

1. lower  $Y$ , but higher  $i$
2. capital inflows
3. dollar appreciation ( $E \downarrow$ )

Net exports:  $NX = \underbrace{(Y - T - C)}_{\text{falls}} + (T - G) \underbrace{-I}_{\text{rises}}$

- ▶ private saving falls (lower  $Y$ )
- ▶  $I$  falls (lower  $Y$  and higher  $i$ )
- ▶ change in  $NX$  is **ambiguous**
- ▶ but empirically  $I$  tends to be more responsive than  $S^p$

## Combining Monetary and Fiscal Policy

	$Y$	$i$	$NX$	$E$
$G \uparrow$	$\uparrow$	$\uparrow$	$\downarrow$	$\downarrow$
$M \uparrow$	$\uparrow$	$\downarrow$	$\uparrow ?$	$\uparrow$

In principle, monetary and fiscal policy can be used jointly to increase output without affecting the trade balance.

But keep in mind: this is for the short run only (prices are fixed).



# International Spillovers

Domestic policies affect other countries through the trade balance.

- ▶ Domestic expansion  $\implies$  more import demand
- ▶ Changes in domestic interest rates  $\implies$  exchange rate changes

Some policies have positive spillovers; others negative.

- ▶ Gains from policy coordination.
- ▶ Potential for policy wars.

# International Spillovers

Suppose that the U.S. is in recession.

Policy option 1: **monetary expansion**:

- ▶ Dollar depreciates:  $NX \uparrow$  likely
- ▶ we borrow demand from foreign countries
- ▶ we export our recession

Policy option 2: **fiscal expansion**:

- ▶ Dollar appreciates ( $NX \downarrow$ )
- ▶ we export demand to foreign countries
- ▶ we export the stimulus

# Policy coordination

Countries can gain by coordinating their policies.

One country may be tempted to improve their trade balance through monetary expansion.

- ▶ avoid fiscal deficits

Foreign countries have an incentive to “retaliate” by expanding their money supplies.

The net effect on trade balances cancels out.

- ▶ “competitive devaluations”

# Trade Restrictions

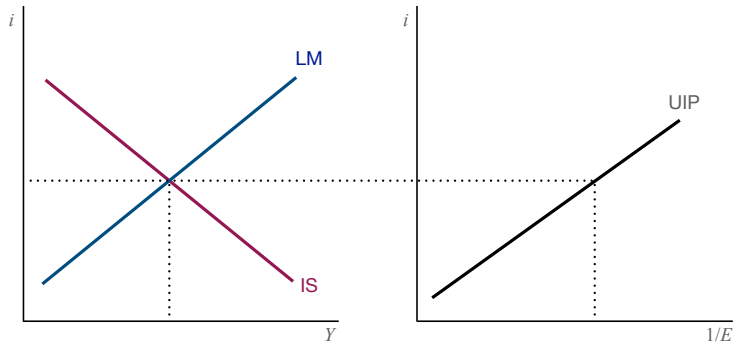
What is the effect of a tariff on imports?

Think of a tariff as improving  $NX$  for given  $(Y, Y^*, \epsilon)$

$$Y = C(Y - T) + I(Y, i) + G + NX \left( Y, Y^*, \frac{1+i^*}{1+i} \frac{1}{E^e}, \tau \right) \quad (11)$$

It has exactly the same effects as a foreign expansion  $(Y^* \uparrow)$ .

# Trade Restrictions



# Trade restrictions

Result: tariffs work!

They improve the trade balance.

Doesn't that contradict our previous discussion?

Recall

$$\frac{NX}{Y} = \underbrace{\frac{Y - T - C}{Y}}_{S^P/Y \text{ unchanged}} + \underbrace{\frac{T - G}{Y}}_{\text{unchanged}} - \underbrace{\frac{I}{Y}}_{\text{ambiguous}} \quad (12)$$

Tariffs produce a short-run stimulus ( $Y \uparrow$ ).

$NX \uparrow$  but  $NX/Y$  not clear.

The lesson remains: trade restrictions don't have a clear effect on the trade balance.

# Reading

Blanchard / Johnson, Macroeconomics, 6th ed., ch. 19, 20