

# 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

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

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

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

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

These solve for  $Y, i, E$ .

## 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

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

Use UIP to substitute out the real exchange rate

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

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

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

►  $i \uparrow$  and  $E^e \uparrow$  lead to dollar appreciation ( $\varepsilon \uparrow$ ) and  $NX \downarrow$

## Modified IS Curve

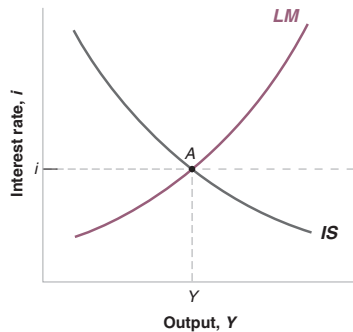
$$IS : Y + C(Y - T) + I(Y, i) + G + NX \left( Y, Y^*, \frac{1+i}{1+i^*} E^e \right) \quad (7)$$

Properties:

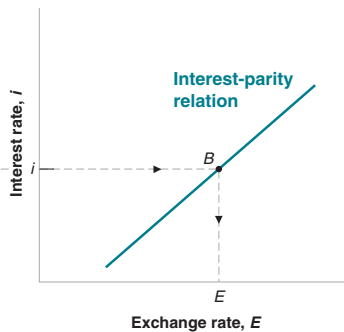
- ▶ downward sloping:  $i \uparrow \implies Y \downarrow$
- ▶ shifters: as closed economy *plus* anything that increases  $NX$

# IS-LM Graph

(a)



(b)





# What Has Changed

Relative to a closed economy:

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

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

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

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

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

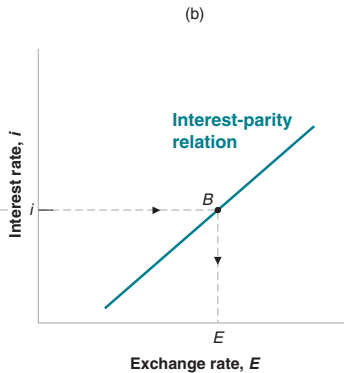
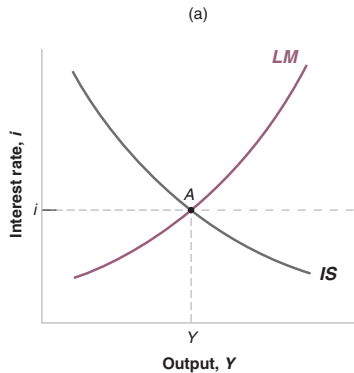
$$UIP : E = \frac{1+i}{1+i^*} E^e \quad (10)$$

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

Endogenous:  $Y, i, E$

# Analyzing Shocks

# Government Spending Rises



# Government Spending Rises

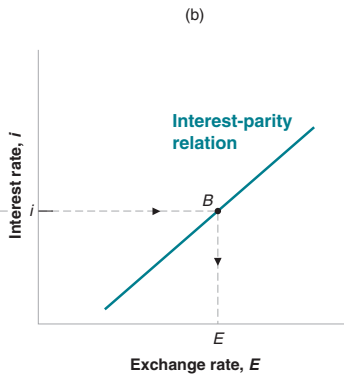
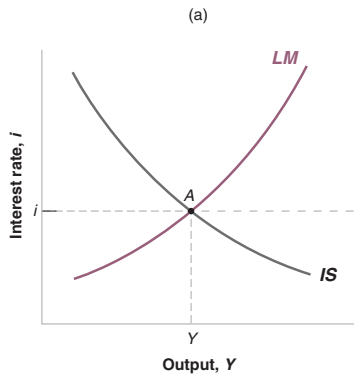
Higher  $G$  leads to:

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

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 ( $E \uparrow$ )
4.  $NX$  initially lower (b/c we have capital inflows)

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

- change in  $NX$  is **ambiguous** once the initial capital inflow has ended

## Combining Monetary and Fiscal Policy

	$Y$	$i$	$NX$	$E$
$G \uparrow$	$\uparrow$	$\uparrow$	$\downarrow$	$\uparrow$
$M \uparrow$	$\uparrow$	$\downarrow$	$\uparrow$	$\downarrow$
Both	$\uparrow$	$-$	$-$	$-$

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

Suppose that the U.S. is in recession.

Policy option 1: **monetary expansion**:

- ▶ monetary expansion leads to depreciation ( $NX \uparrow$ )
- ▶ 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.

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

The net effect on trade balances cancels out.

- ▶ “competitive devaluations”

# Trade Restrictions

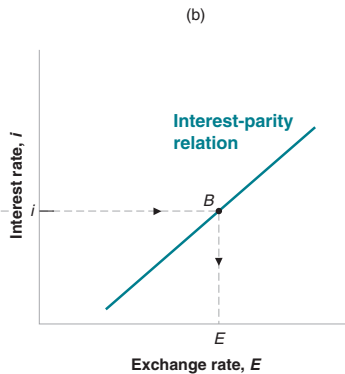
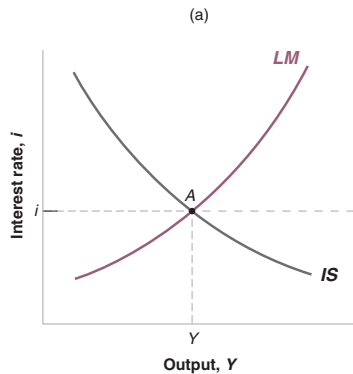
What is the effect of a tariff on imports?

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

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

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

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

- ▶ Private saving rises  
but we probably don't believe this beyond, perhaps, a very short run effect
- ▶ Investment could fall (but ambiguous)

# Trade restrictions

What the model is missing: expenditure switching

- ▶ the dollar appreciates  $\Rightarrow IM \downarrow$
- ▶ in the model: expenditure falls
- ▶ more likely: expenditure switches towards domestic  $C$  and  $I$
- ▶ then the effect on  $NX$  is 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