Open Economy IS/LM Model

Prof. Lutz Hendricks

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Objectives

In this section you will learn

1. how to extend the IS-LM model to an open economy
2. how to analyze monetary and fiscal policy in an open economy
3. why the Central Bank loses control over the money supply under fixed exchange rates

Note: All this is for the short run.

Equilibrium with open economy

We need to clear

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

Four cases:

1. exchange rate: fixed or floating
2. capital mobility: perfect or none
   determines FX market clearing conditions

Open Economy IS Curve

We return to the short-run model where output is determined by aggregate demand

Start from the definition of aggregate demand in dollar terms

$$PZ = P(C + I + G + X) - EP^*IM \qquad (1)$$

P: domestic price level (dollars)

P^*: foreign price level (pesos)

E: exchange rate (dollars/pesos)

Open Economy IS Curve

Divide by P:

$$Z = C(Y - T) + I(Y, r) + G + X - IM/\varepsilon \qquad (2)$$

where $Y - T$ has $+$ below it, and Y, r in I have $+$ and $-$ below them respectively.

IM/ε: dollar value of imports

$\varepsilon = P/EP^*$ is the relative price of foreign goods (the real exchange rate)

- $\varepsilon \uparrow$ means: foreign goods get cheaper

r: real interest rate

Determinants of Imports

Income effect: $Y \uparrow \implies IM \uparrow$

- richer countries import more

Substitution effect: $\varepsilon = \frac{P}{EP^*} \uparrow \implies IM \uparrow$

- dollar appreciates $\implies$ imports rise
- but note that the value of imports, IM/ε, may $\uparrow$ or $\downarrow$

Determinants of Exports

Income effect: $Y^* \uparrow \Longrightarrow X \uparrow$

Substitution effect: $\varepsilon \uparrow \Longrightarrow X \downarrow$

- domestic goods are more expensive

Net Exports

The contribution of international trade to demand:

$$NX = X(\underset{+}{Y^*}, \underset{-}{\varepsilon}) - IM(\underset{+}{Y}, \underset{+}{\varepsilon})/\varepsilon \tag{3}$$

$Y \uparrow \implies$ trade balance $\downarrow$

- richer countries import more

$\varepsilon \uparrow \implies$ trade balance ambiguous

- so we use evidence to sign this effect (below).

IS Curve

Assume that output is determined by demand: $Y = Z$

$$Y = C(\underset{+}{Y-T}) + I(\underset{+}{Y}, \underset{-}{r}) + G + X(Y^*, \varepsilon) - IM(Y, \varepsilon)/\varepsilon \qquad (4)$$

Linear example:

$$\begin{aligned} Y &= \{C_0 + c_1(Y-T)\} + \{I_0 + i_1 Y - i_2 r\} + G \\ &\quad + \{x_1 Y^* - x_2 \varepsilon\} - \frac{im_1 Y + im_2 \varepsilon}{\varepsilon} \\ &= \frac{[C_0 - c_1 T + I_0 + G + x_1 Y^* - im_2] - x_2 \varepsilon - i_2 r}{1 - c_1 - i_1 + im_1/\varepsilon} \end{aligned}$$
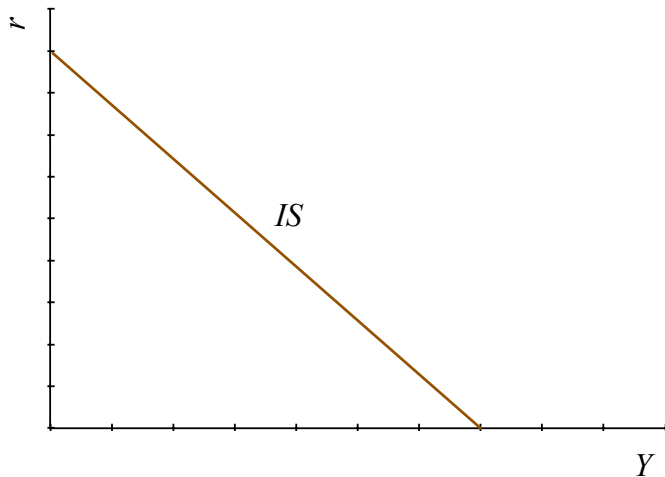
IS Curve

Slope is negative: $r \uparrow \Longrightarrow Y \downarrow$

- same reason as in closed economy (investment falls)

Shifters are

- autonomous demands: C_0, I_0, G, Y^* (positive)
- taxes T (negative)
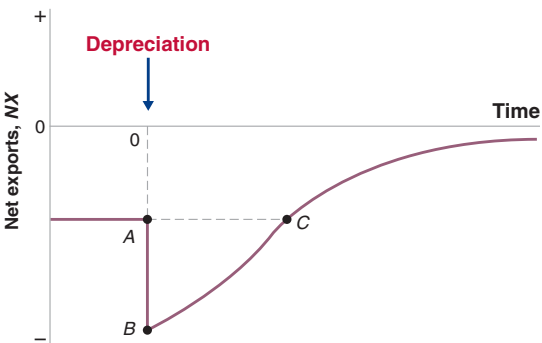- real exchange rate ε

IS Curve

Currency Depreciation

- ▶ Whether a depreciation increases or decreases demand is ambiguous
- ▶ Substitution effect:
    - ▶ dollar depreciates
    - ▶ foreign good become more expensive
    - ▶ $IM \downarrow$ and $X \uparrow$
- ▶ Value effect:
    - ▶ the dollar value of a given IM quantity rises
- ▶ We will assume that a depreciation increases demand (and improves the trade balance):

$$\varepsilon \downarrow \Longrightarrow X - IM/\varepsilon \uparrow \qquad (5)$$

J-Curve

- After depreciation: trade balance typically deteriorates initially
- Quantities take time to adjust
- In the short run the rise in import prices dominates

Foreign exchange market clearing

Exchange rates in the short run

Short-run exchange rates are **asset prices**.

- ▶ Almost all FX trade is due to short-term (often intra-day) asset trading.
- ▶ Trade in goods is too small to play a role.
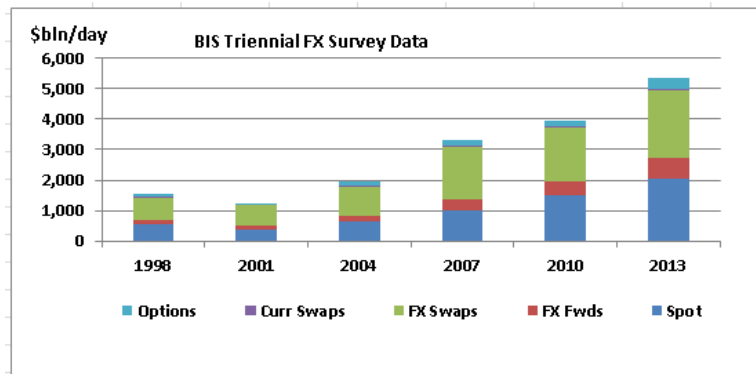
Daily FX trading volume, billions of dollars (Source: BIS)

Exchange rates in the short run

- Asset prices (in liquid markets) tend to fluctuate a lot.
- The reasons for the fluctuations are not well understood.
- Modern asset pricing theory predicts that prices should be much smoother than the data.
- Therefore:
  - *We don't know how short-run exchange rates are determined*.
  - Much of the fluctuations are probably random noise.

What Determines Capital Flows?

Most of the demand for dollars comes from international capital flows (not from trade).

We can get an idea about what moves exchange rates, if we understand what moves capital.

Capital flows into the U.S., if the risk adjusted rate of return of investing in dollars is higher than abroad.

Factors that cause capital to flow into the U.S.:

1. high U.S. interest rate;
2. expected appreciation of the dollar;
3. increasing risk of investing abroad: political instability, external debt, ...

Uncovered Interest Parity (UIP)

UIP is one theory of short-run exchange rate determination.

It does not hold all that well, but it has the right idea...

Definition

Uncovered interest parity holds, if the dollar returns of investing at home and abroad the same

The return of investing abroad

- ► Example: Invest \$100 in Euro
- ► Today's exchange rate is 2 \$/Euro [$E(t) = \frac{1}{2}$]
    - ► Buy 50 Euro
- ► The Euro interest rate is $i_{Euro} = 0.05$
    - ► Earn $0.05 \times 50 Euro = 2.50 Euro$
- ► Next year the exchange rate is 2.2 \$/Euro [$E(t+1) = 1/2.2$]
- ► Sell 52.50 Euro and buy $\$2.2 \times 52.50 = \$115.5$
- ► Rate of return: 15.5%
    - ► 5% interest + 10% Euro appreciation.

The dollar return of investing in Euro

Start with	$1
Convert into Euro	Euro $1/E(t)$
Earn interest	Euro $(1+i_{Euro})/E(t)$
Convert back into $	$ $(1+i_{Euro})\, E(t+1)/E(t)$

$E(t)$ is in $/Euro.

Total return:

$$1 + r_{Euro} = \underbrace{(1+i_{Euro})}_{\textit{interest}}\ \underbrace{E(t+1)/E(t)}_{\textit{capital gain}}$$

Uncovered interest parity

$$1 + i_{\$} = (1 + i_{Euro}) \ E(t+1)/E(t) \tag{6}$$

Risk Premiums

- If currencies differ in risk, UIP subtracts a risk premium from the foreign currency return.

$$1 + i_\$ = (1 + i_{Euro} - RP_{Euro})\ E(t+1)/E(t) \qquad (7)$$

- The same from the European perspective

$$1 + i_{Euro} = (1 + i_\$ - RP_\$)\ E(t)/E(t+1) \qquad (8)$$

- The risk premium must be negative for one country.
- Why?

How shocks affect the exchange rate

▶ Solve the UIP condition for today's spot rate:

$$E(t) = E(t+1) \frac{1 + i_{Euro} - RP_{Euro}}{1 + i_\$} \tag{9}$$

▶ The exchange rate responds to 3 types of shocks:

1. The Euro becomes less risky: $RP_{Euro} \downarrow$. Then $E(t) \uparrow$ (Euro appreciates)
2. The Euro interest rate rises or the dollar interest rate falls: $i_{Euro} \uparrow \Longrightarrow E(t) \uparrow$.
3. The Euro is expected to be more valuable in the future: $E(t+1) \uparrow \Longrightarrow E(t) \uparrow$

▶ Intuition: Good news such as lower risk or a higher interest rate make the Euro attractive to investors. Its value rises.

Is the Euro strong when the interest rate is high?
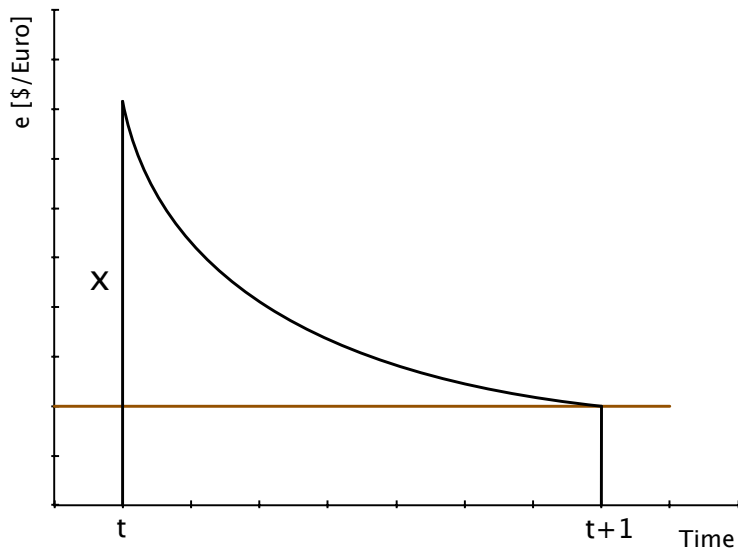
Today: $i_\$ = i_{Euro} = 10\%$; $E(t) = 1$ [$/Euro]

UIP: Investors must expect E to remain constant

Shock: Euro interest rate rises to 15%

Key assumption: No change in $E(t+1)$!

Result:

Is the Euro strong when the interest rate is high?

x is the expected appreciation of the dollar: $x(t) = E(t)/E(t+1)$.

Expectations Matter

Fact

UIP determines $E(t)$ only relative to the future $E(t+1)$.

Changes in expectations about $E(t+1)$ are reflected immediately in the spot rate.

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Example

Investors doubt stability of the peso. Lower $E(t+1)$ or higher RP imply $x < 0$.

Violation of UIP: $i_\$ > i_{Peso} + x - RP$.

Traders sell pesos until UIP is restored.

Peso depreciates up to the point where $x = 0$.

Possibility of self-fulfilling prophecies

- Without an anchor to pin down the long-run exchange rate, any E can be an equilibrium

- Mean-reversion to PPP (purchasing power parity) provides an anchor, but it is weak.

- This is generally true for asset prices.

- This is one reason why asset prices are so volatile.

Summary

We now have the pieces required to figure out equilibrium in the open economy:

1. good market clearing: IS

$$Y = C(\underset{+}{Y - T}) + I(\underset{+}{Y}, \underset{-}{r}) + G + X(Y^*, \varepsilon) - IM(Y, \varepsilon)/\varepsilon \qquad (10)$$

2. money / bond market clearing: LM

$$M/P = YL(i) \qquad (11)$$

3. FX market clearing
   3.1 perfect / high capital mobility: UIP

   $$E = \frac{1 + i^*}{1 + i} E^e \qquad (12)$$

   3.2 no capital mobility:

   $$NX = X - IM = 0 \qquad (13)$$

Some Comments

1. **LM** is unchanged: we assume that only locals hold currency
2. Since we take prices as given, we can use the nominal interest rate i instead of the real one (r)
3. We assume that a depreciation improves the trade balance
4. We rewrote UIP:

$$1 + i = (1 + i^*)E/E^e \tag{14}$$

Reading

Blanchard / Johnson, Macroeconomics, 6th ed., ch. 18-20