Exchange Rates

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Econ520

January 3, 2016

Objectives

We want to extend our models to open economies.

First, we need to get some basic concepts out of the way.

In this section you will learn

1. what a real exchange rate is
2. how exchange rates are determined in the long run (PPP)
3. how exchange rates are determined in the short run (interest parity)

Nominal exchange rate

- The exchange rate is the relative price of 2 currencies.
- \$1 - ¥116
- It comes in 2 "directions":
  1. $E_{\$/¥}$: the price of yen: 1/116 \$/¥
  2. $E_{¥/\$}$: the price of \$: 116 ¥/\$
- $E_{¥/\$}$ rises - dollar **appreciates**.

Nominal exchange rate

Exchange rates move a lot - short and long run

Real exchange rate

Definition

The real exchange rate answers the question: how much do the same goods cost in the U.S. relative to Japan?

- Form a "basket" of goods.
- Compute its cost in the U.S. ($\$P$) and Japan ($¥P^*$).
- Convert into dollars using the nominal exchange rate: the basket costs $E_{\$/¥}P^*$ in Japan.
- The ratio of dollar costs is the real exchange rate:

$$RER = P/(E_{\$/¥}P^*) \tag{1}$$

Real exchange rate

- The RER has no units:

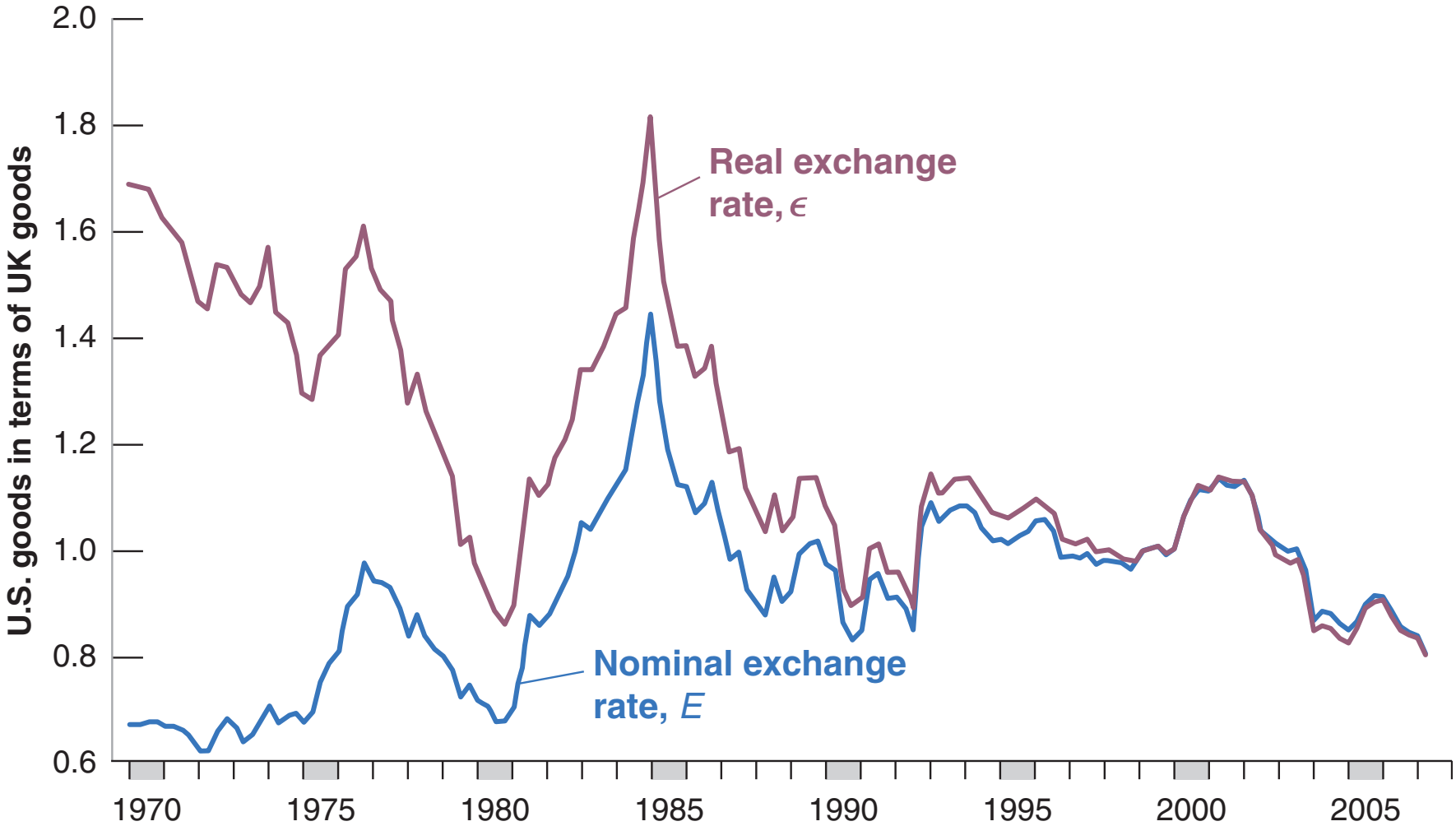
$$[RER] = \frac{\$/good}{\$/yen \times ¥/good} \tag{2}$$

- If $RER = 1.5$ this means: in the U.S. goods cost 50% more than in Japan.
- Note: some people denote RER the other way around: $E_{\$/¥} P^*/P$.

Real exchange rate

- Real exchange rates move a lot as well - long-run and short-run.
- Why?
- P and P^* move very slowly.
- E moves a lot.
- The RER closely follows the nominal exchange rate, except over long horizons.

Example: Real Exchange Rate



Short run: E dominates the real exchange rate

Example: Real Exchange Rate

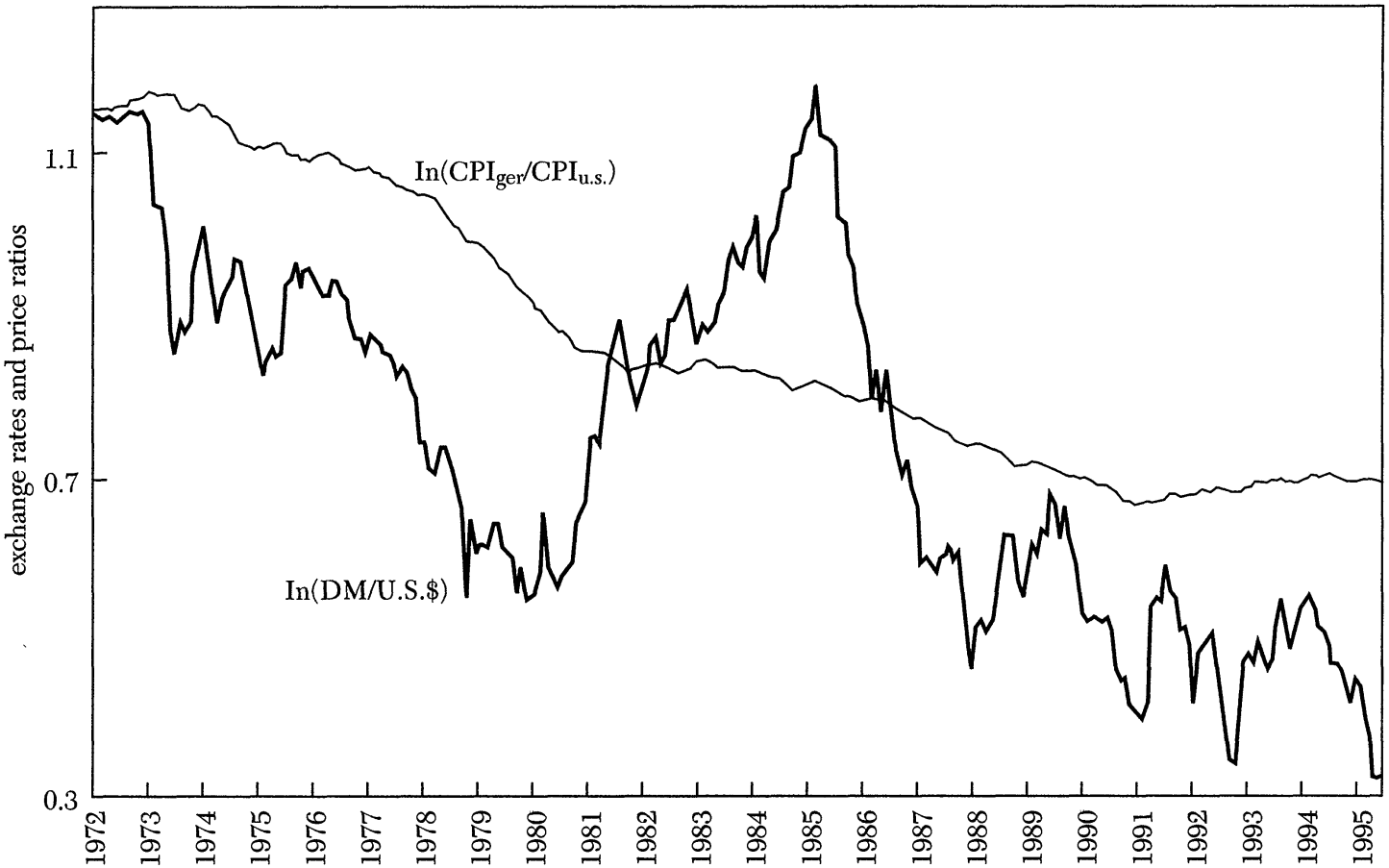


Figure 2. DM/U.S.$ exchange rate and ratio of German to U.S. CPIs, Jan. 1972–May 1995

Source: Rogoff (1996)

Long run: relative prices dominate the exchange rate

What Determines Exchange Rates in the Long Run?

Purchasing Power Parity

Purchasing Power Parity (PPP)

An old and plausible theory of long-run exchange rate determination: **absolute PPP**.

Definition

Absolute PPP holds when the RER equals 1.

A basket of goods costs the same (in dollar terms) in both countries.

Absolute PPP

Absolute PPP generalizes the **law of one price (LOP)**

Definition

The LOP holds if the same good costs the same (in dollar terms) in all countries.

Why would LOP tend to hold?

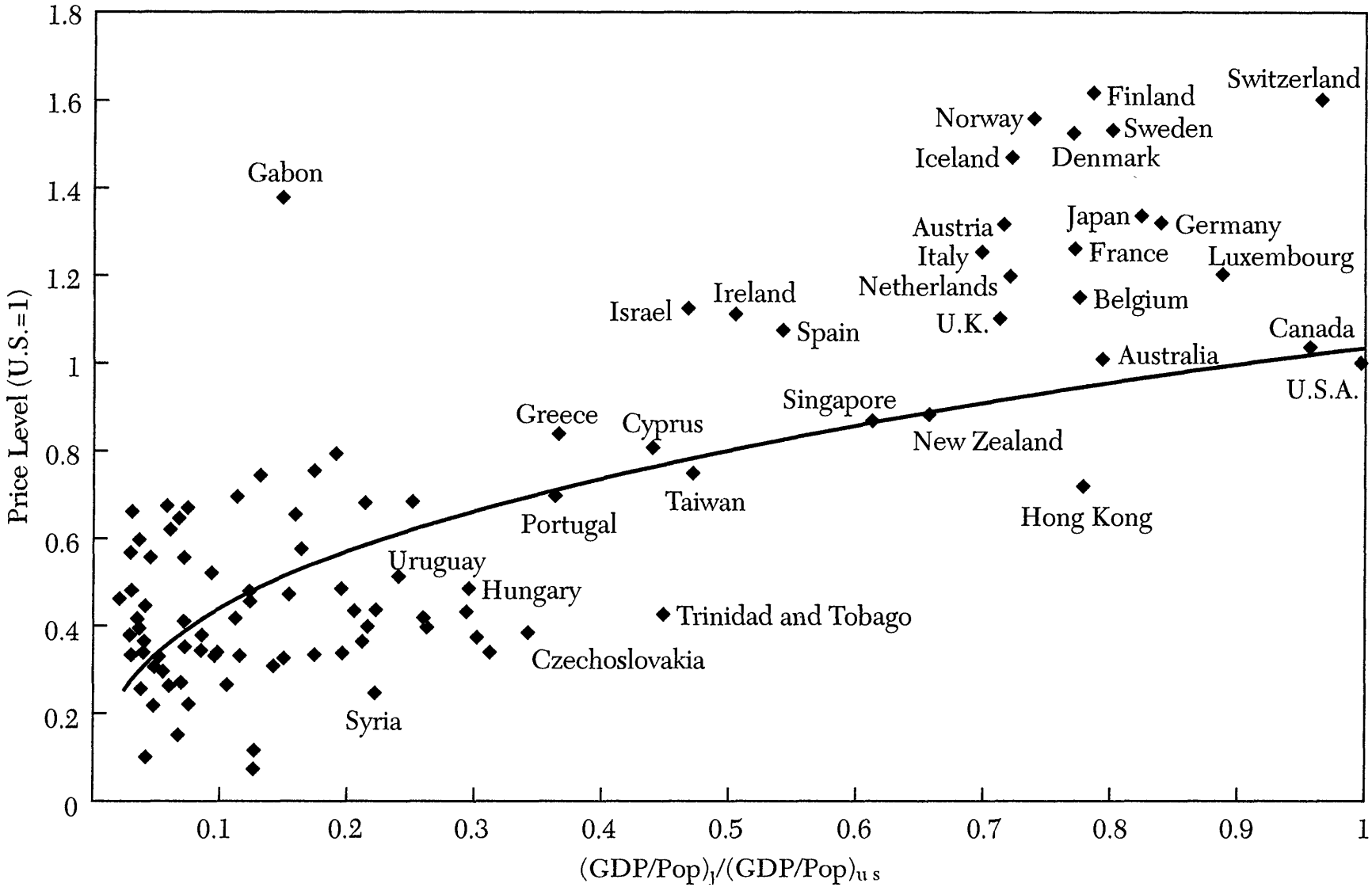
In reality, the LOP does not hold too well

- Why not?

Absolute PPP

- Absolute PPP claims that the LOP holds **on average** for a bundle of goods.
- Any given good may be a bit cheaper or more expensive in some country.
- But goods are not systematically cheap or expensive in some countries.

Absolute PPP Fails



Source: Rogoff (1996)

Why does absolute PPP fail?

Non-traded goods are systematically cheaper in poorer countries.

	Big Mac price in local currency	Exchange rate per dollar ($)	Big Mac price in dollars
United States	3.10 dollars	1.00 dollars/$	3.10
Euro area	2.94 euros	0.78 euros/$	3.77
China	10.50 yuan	8.03 yuan/$	1.31
Japan	250.00 yen	112.00 yen/$	2.23
Mexico	29.00 pesos	11.30 pesos/$	2.57
Argentina	7.00 pesos	3.06 pesos/$	2.29
Brazil	6.40 reais	2.30 reais/$	2.78
South Africa	13.95 rand	6.60 rand/$	2.11

Source: "McCurrencies," *The Economist*, May 26, 2006.

TABLE 15.1 The Big Mac Index

Relative PPP

Definition

Relative PPP holds if the real exchange rate is constant over time.

- Think of this as a long-run statement.
- The RER tends towards a fixed value for each country.
- Temporary deviations are ok.

Relative PPP

- The evidence supports relative PPP.
- But the RER can deviate from relative PPP for long periods of time.
- The tendency to revert to relative PPP is weak / gradual.
- Still, relative PPP is the best predictor of long-run exchange rates.

Relative PPP: Implications

- High inflation currencies should depreciate.
- To see this, write relative PPP in growth rates:

$$g(RER) = g\left(\frac{P}{E\ P^*}\right) = \pi - \pi^* - g(E) = 0 \tag{3}$$

- The rate of depreciation should match the inflation differential.

$$g(E) = \pi - \pi^*$$

- That means:

In the long-run, the exchange rate is completely determined by monetary policies.

Relative PPP

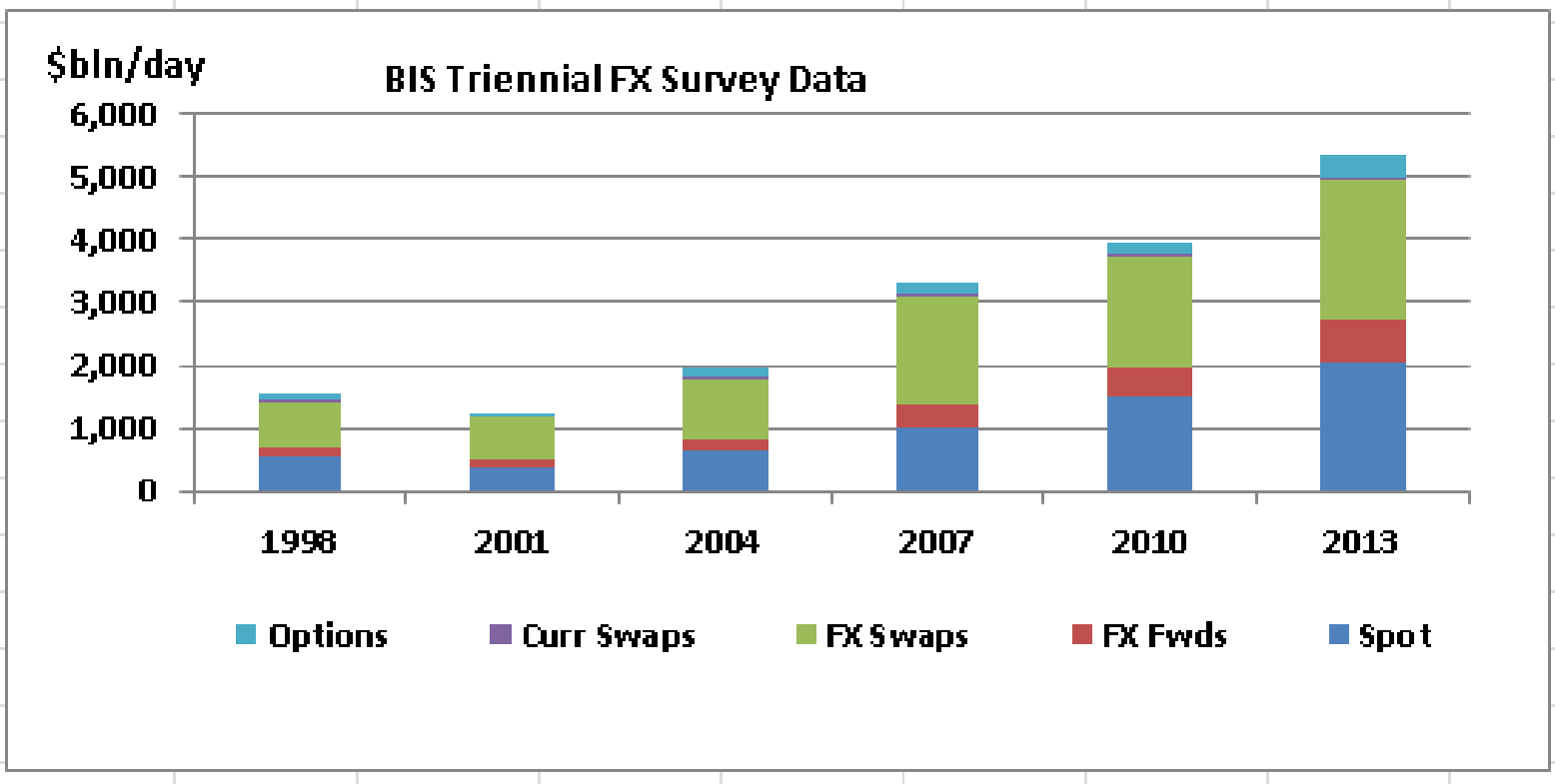
- Relative PPP is the best predictor of long-run exchange rates.
- But:
  - there are large short-run deviations from PPP
  - reversion to PPP is quite slow in the data.

Exchange rates in the short run

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.

What Determines Capital Flows?

- 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:

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

Uncovered interest parity

$$1 + i_{\$} = (1 + i_{Euro})\ E(t+1)/E(t) \tag{4}$$

Risk Premiums

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

$$1 + i_{\$} = (1 + i_{Euro} - RP_{Euro})\ E(t+1)/E(t) \tag{5}$$

- The same from the European perspective

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

- 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:

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

- 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%

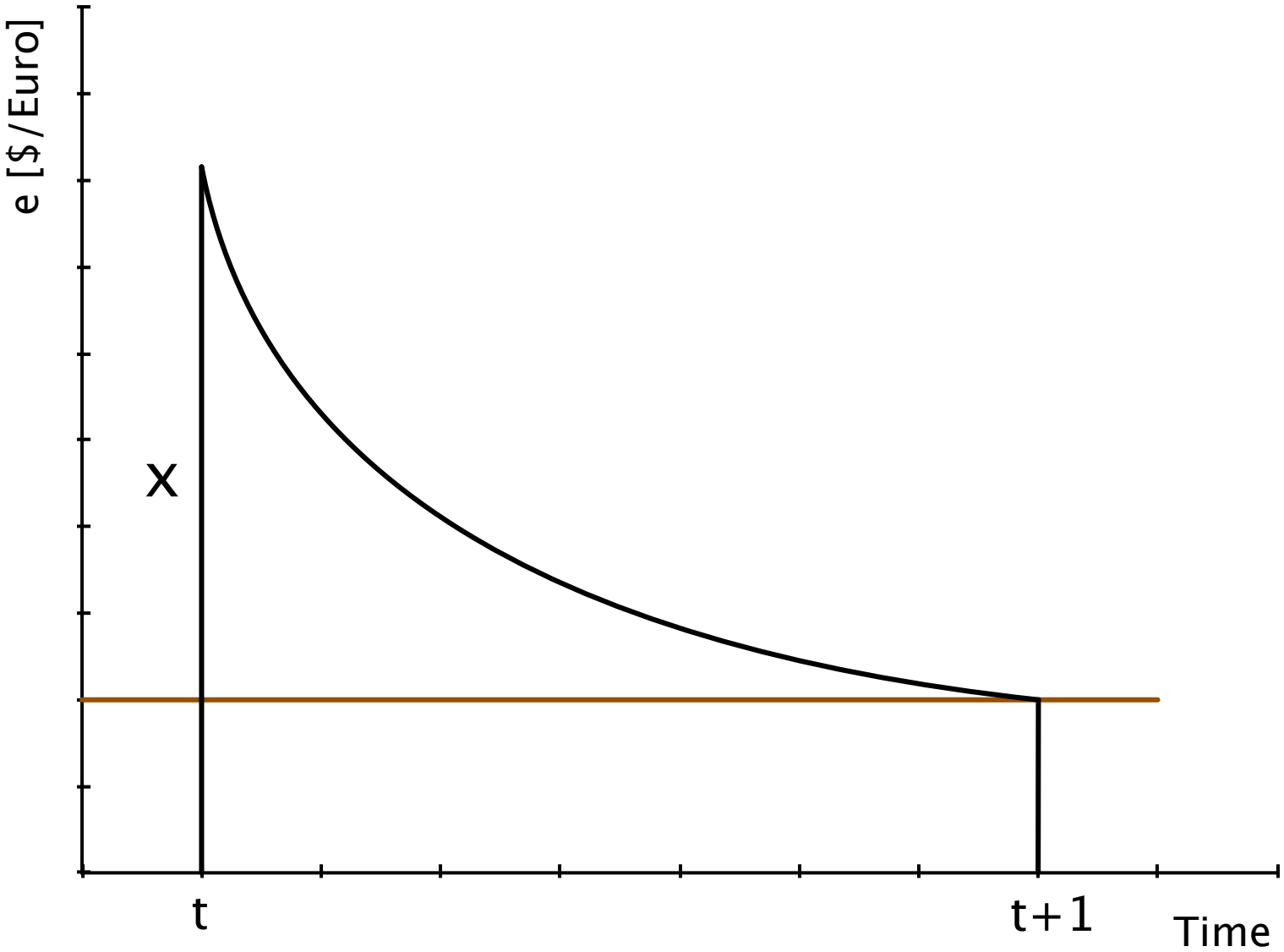
Key assumption: No change in $E(t+1)$!

Result:

- Euro appreciates when i_{Euro} rises
- Euro depreciates while i_{Euro} is high

Intuition: The expected depreciation must offset the gains from higher interest income.

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 provides an anchor, but it is weak.
- This is generally true for asset prices.
- This is one reason why asset prices are so volatile.

Reading

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