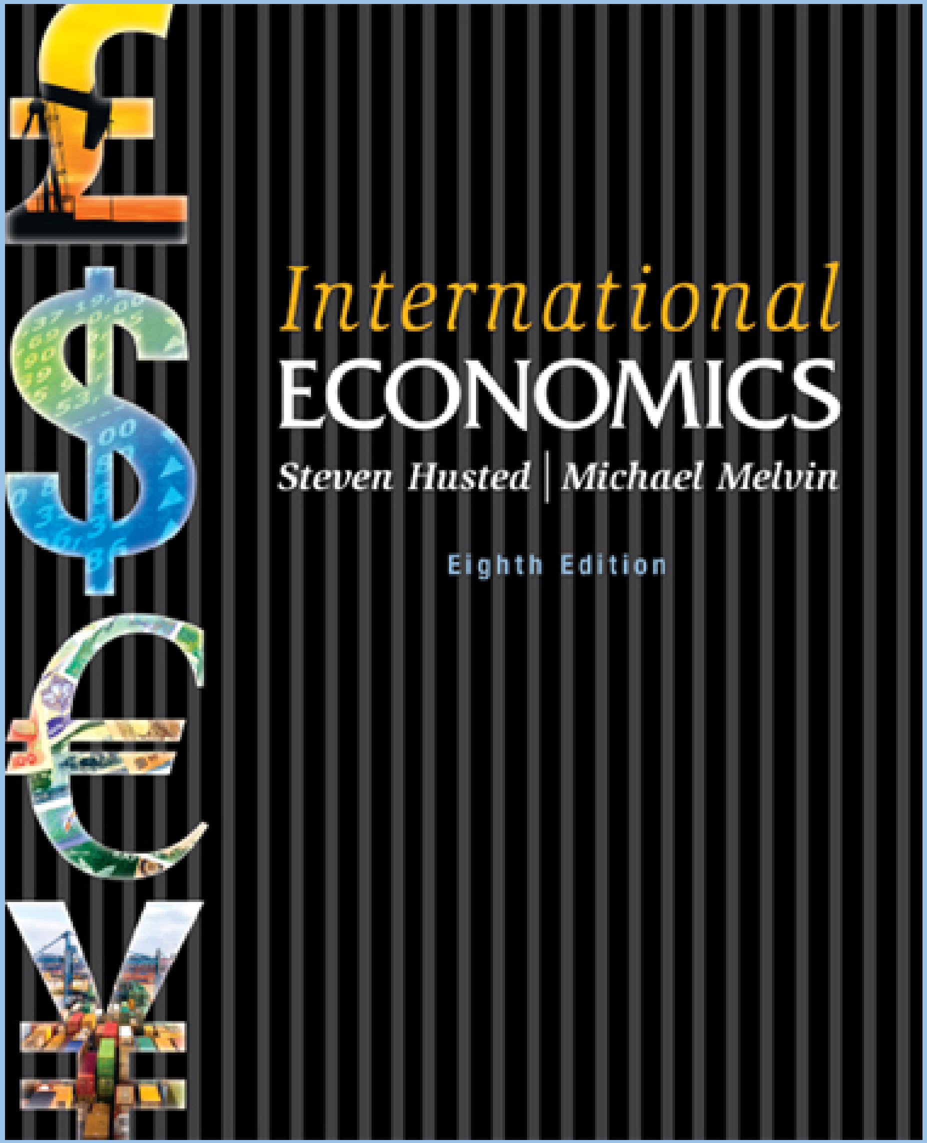
Chapter 15

Exchange Rates, Interest Rates, and Interest Parity: Adapted by Harris Dellas



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Topics to be Covered

- Interest Rate Parity
- Excess returns
- Real Interest Rate, Fisher Equation
- Exchange Rates, Interest Rates, and Inflation
- Expected Exchange Rates and the Term Structure of Interest Rates

Interest Parity

- The interest parity relationship is a result of profit-seeking arbitrage activity called **covered interest arbitrage**.
- A Swiss investor deciding between investing in CHFs or in USD must consider:
  - The interest rates, $i_{\$}$ and i_{CHF}
  - The spot exchange rate, S , (in CHF per USD)
  - The forward exchange rate, F, (in CHF per USD)

Interest Parity (cont.)

- By investing 1 CHF at home, the Swiss investor can earn $1 + i_{CHF}$ CHF after one period. Ex: $\mathbf{i_{CHF}} = \mathbf{10\%}$ 1 CHF → 1.1 CHF
- Or, since 1 USD = S CHF, the Swiss investor can convert 1 CHF into 1/S USD, invest in the USA and earn $(1/S)*(1 + i_\$)$ USD
- *Ex:* $\mathbf{i_\$} = \mathbf{20\%}$, **S=2**: 2 chf=1 USD, convert: 1 chf →0.5 usd, invest:0.5 usd→0.6 usd (0.5*1.2)
- Since future spot rates are unknown, the investor can eliminate the uncertainty over the future CHF value of the investment with a forward exchange contract involving the forward rate, F. That is, by converting $(1 + i_\$)*(1/S)$ USD into $(1 + i_\$)*(1/S)*F$ CHF
- Ex: 1 usd= F chf, 0.6 usd = 0.6*F chf

Covered Return

- **Covered return** is the domestic currency value of a foreign investment when the foreign currency proceeds are sold in the forward market for domestic currency.

- In our example, the covered return is equal to $(1 + i_{\$})F/S$ CHF. Arbitrage between the two investment opportunities results in

$1 + i_{CHF} = (1 + i_{\$})*(F/S)$, that is,

$$\frac{1+i_{CHF}}{1+i_{\$}} = \frac{F}{S}$$

Ex: 1.1/1.2=F/2 → F =2.2/1.2=1.83 CHF is ''expected'' to appreciate (from 2 to 1.83)

Covered Interest Rate Parity

- Using f=logF and s=logS one can rewrite this equation as approximately

$$i_{CHF} - i_{\$} = \frac{F - S}{S} = f - s$$

Covered interest rate parity states that the forward premium (or discount) is equal to the interest differential.

:

Uncovered Interest Rate Parity

- If one chooses instead not to sell the foreign currency forward the *expected* return in CHF is $(1 + i_{\$})*(E_tS_{t+1}/S_t)$ where E denotes expectation. The two strategies are expected to yield -on average- the same return when **uncovered** IRP holds

$$\frac{1+i_{CHF}}{1+i_{\$}} = \frac{E_t S_{t+1}}{S_t}$$

- Or, approximately

$$i_{CHF} - i_{\$} = \frac{E_t S_{t+1} - S_t}{S_t} = E_t s_{t+1} - s_t$$

Excess returns, carry trade

- Excess return of keeping a risky position: $s_{t+1} - f_t$
- Carry trade: Borrow in the low interest rate currency (say CHF) and invest in the high interest rate currency (say, USD). Face future risk of exchange rate change.
- Return on carry trade, μ

$$\mu_t = S_{t+1}(1+i_\$)/S_t - (1+i_{CHF}) \approx s_{t+1} - s_t + i_\$ - i_{CHF}$$

- Profit from lower interest rate and if CHF depreciates (capital gain)

Carry Trade

Ex: i_{CHF} =10%, $i_{\$}$ =20%, S(t)=2, F(t)=1.833

- Borrow 1000 CHF at 10%, convert into 500 USD, invest at 20%, end up a year later with 600 USD.
- If S(t+1) = F(t) then 600 USD are worth 600*1.833=1100 CHF. Pay back loan+interest (1100 CHF), 0 profit from carry trade.
- If S(t+1) = 2>F(t) then 600 USD are worth 600*2=1200 CHF. Pay back loan+interest (1100 CHF), 100 CHF profit from carry trade.
- If S(t+1) = 1.6 < F(t) then 600 USD are worth 600*1.6=960 CHF. Pay back loan+interest (1100 CHF), 140 CHF loss from carry trade.

Carry trade

- During the 2000s people outside CH were borrowing in CHF (and were buying assets in other currencies, e.g a house in Greece).
- A real example: A 20 year loan of 200000 CHF at 3% in 2006 (rather than at 5% in EUR). Monthly payment =1092 CHF.
- From 1998-2006, average CHF/EUR rate ≈ 1.5.
- At that rate, need 1092/1.5 = 728 EUR per month.
- Now the CHF/EUR=1.1. Need 993 EUR per month, 36% more!
- Had the CHF/EUR rate stayed at its historical average, the carry trade would have produced a profit of 880-728=152 EUR per month (880 would have been the monthly payment on the equivalent EUR loan of 133333 EUR =200000/1.5 EUR).

Tests of excess returns

- If the forward rate is an unbiased predictor of future exchange rate, i.e <u>on average</u> $s_{t+1} = f_t$, then the expected *average* excess return (or, the return to carry trade), $s_{t+1} - f_t$ is zero as $E_t s_{t+1} = f_t = s_t*(1+i_{CHF})/(1+i_{\$})$
- If it is not zero. Can the excess return from t to t+1 be predicted by some variable whose value is known at time t such as the carry?

- Excess Return: $ER_t = a + b*\mu_t + u_t$ $\mu_t = s_{t+1} - s_t + i_{\$} - i_{CHF}$
- Or, equivalently (the famous Fama regression)
- $s_{t+1} - s_t = c + d*(i_{CHF} - i_{\$}) + u_t$

- Test of no excess returns: c= 0; d= 1

Tests of excess returns (cont'd)

- All tests indicate that excess return is non zero and that d< 1 and often < 0, that is, the carry trade is profitable.
- Enjoy -on average- higher interest rates and capital gains too!

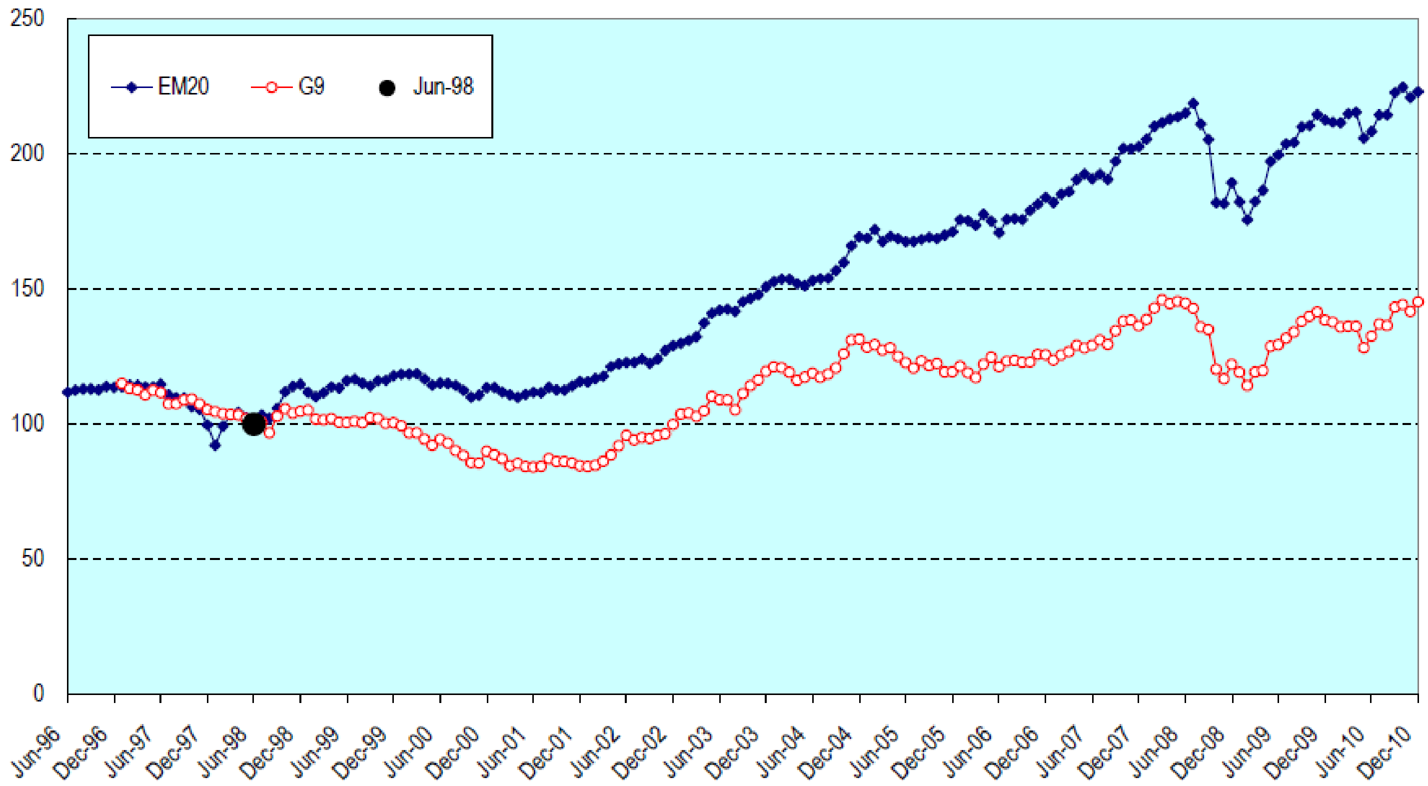
- Explanations for this result:
- The excess return is compensation for higher risk

Choice between 100 and 0 and 200 with coin toss (prob=0.5). The expected value of this lottery is 100? Will its price be 100? No if people are risk averse.

- The excess return is due to irrationality, biases in forecasts, etc.

Figure 1: Cumulative USD Excess Returns, EM 20 and G9, June 1996 - December 2010

June 1998 value is set to100



Interest Rates and Inflation

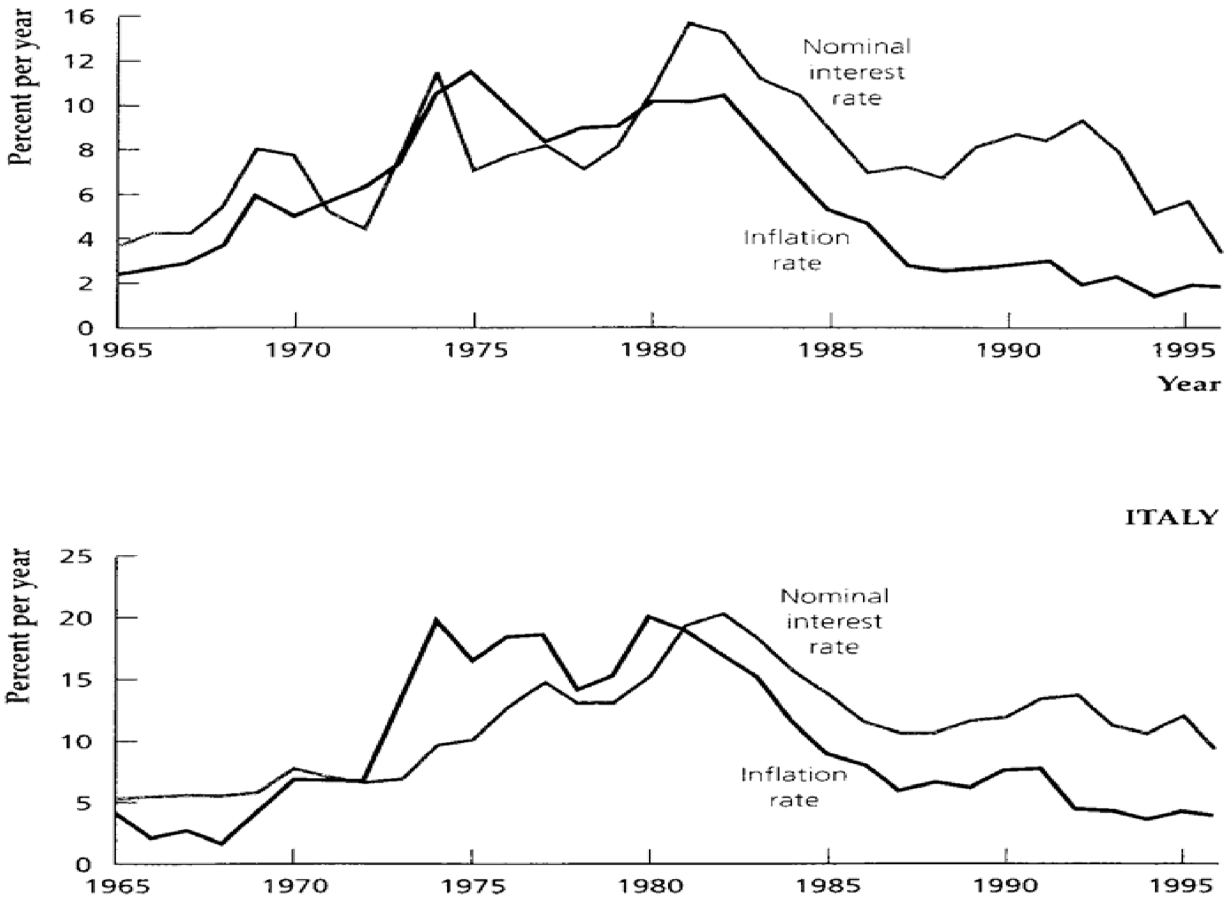
- **Nominal Interest Rate**—the interest rate actually observed in the market.
- **Realized –ex post- Real Interest Rate (RRIR)**—the nominal interest rate minus the inflation rate.
- **Expected –ex ante- Real Interest Rate (ERIR)**—the nominal interest rate minus expected inflation.
- ERIR is the more important concept as it is used as the basis for economic decisions.

Fisher Equation

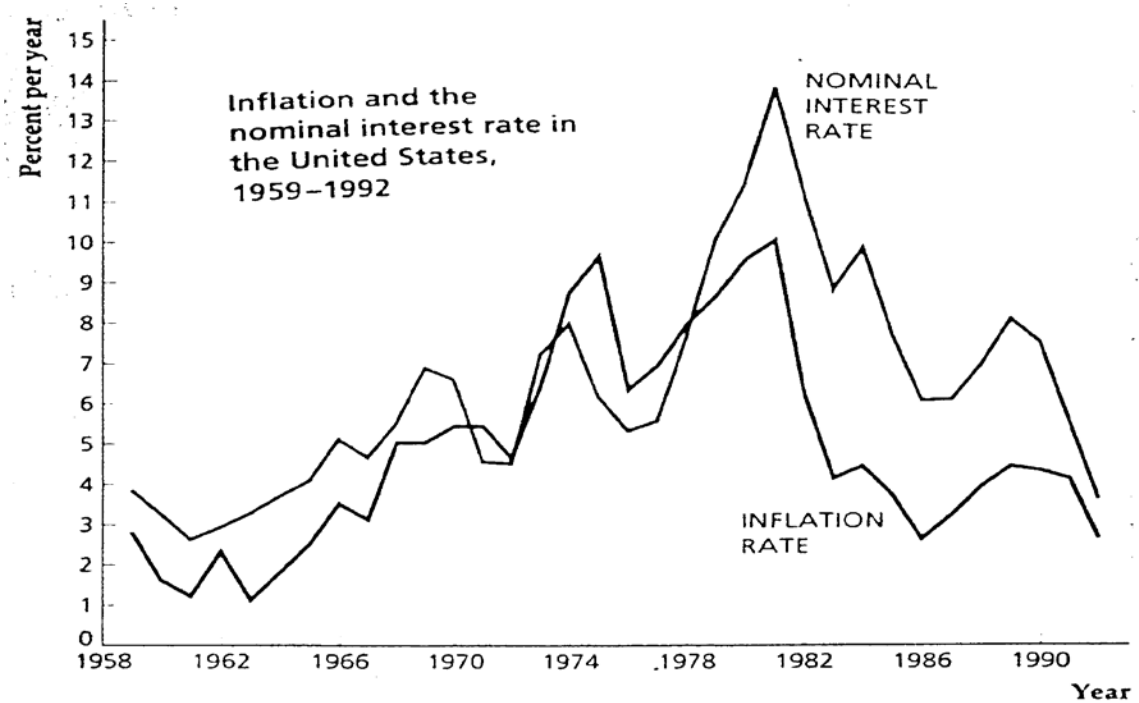
- The relationship between ex ante real interest rates and inflation is given by the **Fisher equation**:

$$i = r + \pi^e$$

where i is the nominal interest rate, r is the real interest rate, and π^e is the expected rate of inflation.



Percent per year
16
12
10
8
6
4
2
0
1965
1970
1975
1980
1985
1990
1995
Year
Nominal interest rate
Inflation rate
ITALY
Percent per year
25
20
15
10
5
0
1965
1970
1975
1980
1985
1990
1995
Nominal interest rate
Inflation rate


Inflation and the nominal interest rate in the United States, 1959–1992
Percent per year
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1958
1962
1966
1970
1974
1978
1982
1986
1990
Year
NOMINAL INTEREST RATE
INFLATION RATE

Interest Rates, Exchange Rates, and Inflation

- Ex ante real interest rates are equalized across countries when the Fisher equation, uncovered interest rate parity, and relative purchasing power parity all hold.

$$r_{CHF} - r_{\$} = i_{CHF} - i_{\$} - (\pi^e_{CH} - \pi^e_{US}) = f(t) - s(t) - (E_t\, s(t+1) - s(t))$$

- Interest rates, inflationary expectations, and exchange rates are all jointly determined and affected by government policy changes and other news.

Interest rates and the exchange rate: Another perspective

- Real interest rates and exchange rates
- We have used IRP to argue that if country A's nominal interest rate is higher than that in B, then A's currency will become weaker (depreciate).
- In the real world, we often hear that an increase in the nominal interest rate typically strengthens (appreciates) a currency.
- The distinction between different sources of changes in nominal interest rates (Fisher equation):

real interest rate (r) vs expected inflation (π^e)

$r \uparrow \Rightarrow s \downarrow$ (appreciation) $\pi^e \uparrow \Rightarrow s \uparrow$ (depreciation)

(s is the exchange rate chf/usd)

Real Interest Rates and Exchange Rates (cont'd)

- Empirical evidence
- In low inflation environments an increase in the nominal interest rates is typically associated with a currency appreciation. The opposite in high inflation environments.

- Applications for CH monetary policy:
- Quantitative easing (QE) in the Eurozone and the abandonment of the CHF/EUR floor
- The use of negative interest rates in CH

Term Structure of Interest Rates

- There is no such thing as *the* interest rate for a country. Many interest rates
- **Term structure of interest rates**—the pattern of interest rates over different terms of maturity.
- Theories of the –slope- of term structure:
- the **Expectations Hypothesis** different term bonds can be viewed as a series of 1-period bonds.
- **Market Segmentation Theory**
- Interpretation of slope

Expected Exchange Rates and Term Structure of Interest Rates

- Refer to Figure 15.1 Eurocurrency Interest Rates
- If the term structure lines for two countries are:
  - Parallel, then exchange rate changes are expected to be constant
  - Diverging, then the high-interest-rate currency is expected to depreciate at an increasing rate over time
  - Converging, then the high-interest-rate currency is expected to depreciate at a declining rate relative to the low-interest-rate currency

FIGURE 15.1 Eurocurrency Interest Rates for July 13, 2008