IFM 2014 Lecture 6

Equilibrium exchange rate concepts and exchange rate risk

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Outline of lecture

Lecture 6

- Uncovered interest parity (UIP)

    1. Empirical evidence
    2. UIP and the exchange rate risk premium
    3. The Carry Trade

- Equilibrium exchange rates

- Models of equilibrium exchange rates

Uncovered interest parity

- Recall the UIP condition:

$$\boxed{i = i^* + \frac{\Delta S^e}{S}}$$

where

$$i = \text{nominal interest rate on domestic bonds}$$
$$i^* = \text{nominal interest rate on foreign bonds}$$
$$\frac{\Delta S^e}{S} = \text{expected rate of depreciation of the home currency}$$

- UIP states that high-interest currencies will be expected to depreciate

Empirical evidence on UIP

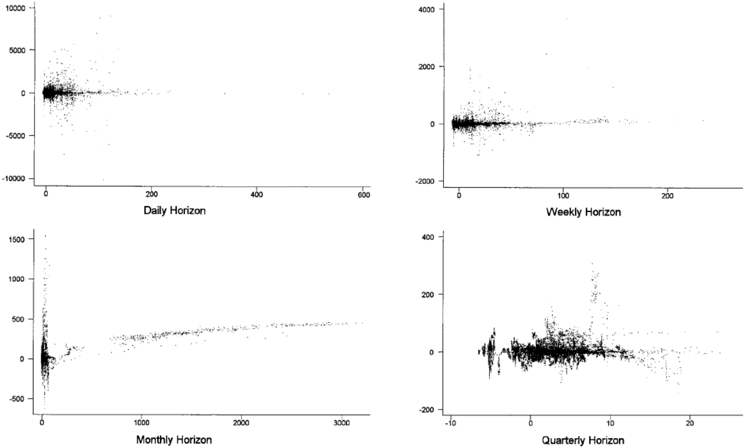
- If investors have rational expectations, expected and actual exchange rate changes should be equal **on average**

- This suggests that we can test UIP by looking at whether high-interest curriencies do actually depreciate

- The results of these tests were not good news for UIP!

- The next slide includes advanced and developed economies and shows that the relationship between interest differentials and depreciation predicted by UIP is not present in the data

Empirical evidence on UIP



Annualized Percentage Changes of Daily Data, 1990s

Exchange Rate Changes (y-axis) against Interest Differentials (x)

Source: Flood and Rose (2002), UIP in Crisis

Empirical evidence on UIP

- There is no clear relationship between exchange rate changes and interest rate differentials on the previous slide
- Moreover, exchange rate changes are far larger than interest differentials in percentage terms
- Could this be due to exchange rate risk?

Exchange Rate Risk

- We shall use the term **exchange rate risk** to refer to real-world risks investors face when choosing between domestic and foreign bonds

- These sources of risk include 'currency risks' and 'country risks'

- Currency risks arise because foreign and domestic bonds are denominated in different currencies

- Country risks arise because bonds are issued by countries with different political regimes and laws

Currency risks

- Currency risks include
  1. **Inflation risk**
  2. **Exchange risk**
- The higher inflation risk at home relative to abroad, the higher will be the exchange rate risk premium RP
- The future exchange rate is not known with certainty, so there is exchange risk when investing in foreign bonds
- Risk-averse investors will require a risk premium on foreign bonds to compensate for this risk

Country risks

- Country risks include

  1. **Exchange control risk** – eg risk of a change in the tax rate on bond interest payments
  2. **Default risk** – government refuses to pay back its debt, ie interest and/or principal are withheld
  3. **Political risk** – risk that restrictions could be imposed on investments or that political environment could lead to lost investment

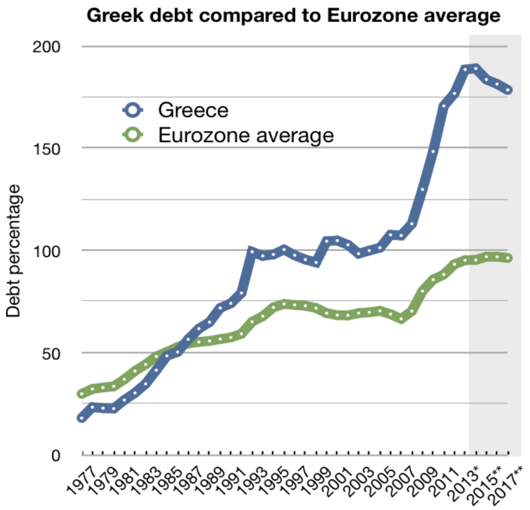
- **Example:** if a new government is installed in a foreign country, we might expect both political risk and exchange control risk to increase

- This would push up risk on foreign bonds relative to home bonds

Default risk: the Greek sovereign debt crisis

- In June 2005, interest rates on 10-year Greek government debt reached an all time low of 3.21%
- By March 2012, these interest rates had risen to almost 50%!
- Over the same period, interest rates remained low in countries such as Germany, the UK and the US. This was partly due to the scale of Greece's government debt.
- Over the period 2005-2012, Greek government debt rose from around 100% of GDP to 170% of GDP

Debt to GDP ratio in Greece since 1977



Source: Eurostat (1/2013)
*estimates
**estimates from Ernst & Young using data from Oxford Economics (3/2013)

Default risk: the Greek sovereign debt crisis

- In short, investors became concerned that Greece would be unable to make its debt repayments
- This meant that in order to borrow the Greek government had to offer high interest rates to compensate lenders for the perceived risk of default
- On 9 March 2012 this perception was shown to be correct – Greece formally defaulted on its debt obligations by swapping investors' existing bonds for longer-dated ones with less than half the face value
- When a government has to make high interest repayments to compensate investors for risk, we say it is paying a **risk premium**

The Exchange Rate Risk Premium

- UIP assumes that investors are risk-neutral – ie they compare the expected return on foreign bonds with the return on domestic bonds
- It is more plausible that investors are **risk-averse**, since they care about both returns and return risk
- If investors view one bond as more risky than the other, then the risky bond will need to pay a higher expected return
- This compensation for bearing additional risk is known as the **exchange rate risk premium**

The Exchange Rate Risk Premium

- Adding a risk premium gives a risk-adjusted version of UIP:

$$\boxed{\textbf{RAUIP:} \quad i = i^* + \frac{\Delta S^e}{S} + RP}$$

where

$$RP = \text{risk premium required on domestic bonds}$$

- If domestic bonds are viewed as more risky than foreign bonds, the risk premium is positive

- If foreign bonds are viewed as more risky, the risk premium is negative

The Exchange Rate Risk Premium: an example

- Suppose interest rates are 4% in the UK and 1% in Japan
- UIP requires an expected depreciation in the Pound of 3%
- With RAUIP, any expected depreciation in the Pound can be rationalised as long as the risk premium makes up the difference
- **Examples**
  1. If $\frac{\Delta S^e}{S} = 2\%$, then $RP = 1\%$
  2. If $\frac{\Delta S^e}{S} = 4\%$, then $RP = -1\%$
- Since interest rates and exchange rate expectations change, a **time-varying** risk premium is needed to explain deviations from UIP

The Exchange Rate Risk Premium: evidence

- To test whether exchange rate risks explain deviations from UIP, we need a theoretical model of the risk premium
- Models predict that the risk premium will depend on how strong the link is between consumption and bond returns
- As noted by Mark and Woo (1998), this link appears to be too weak to explain deviations from UIP
- Predicted risk-premiums have the wrong sign and are not volatile enough – or large enough – to explain UIP deviations

The Exchange Rate Risk Premium: summary

- The ERRP could partly explain deviations from UIP, but there are some puzzling featues in the data
- For example, numerous studies have shown that high-interest currencies tend to appreciate over time
- This requires a large risk premium because it is the exact opposite of what UIP predicts!
- The **Carry Trade** is an attempt to exploit systematic deviations from UIP in order to make a profit

The Carry Trade

- The Carry Trade is a strategy that consists of borrowing low-interest currencies and lending high-interest currencies
- Investors in the Carry Trade attempt to capture the interest rate differential, which they believe will not be offset by a change in the exchange rate
- The Carry Trade therefore DOES NOT make sense according to UIP!
- A Carry Trade strategy could make a profit in any particular year, but it could just as easily make a loss. But according to UIP, Carry Trade should NOT be profitable on average.

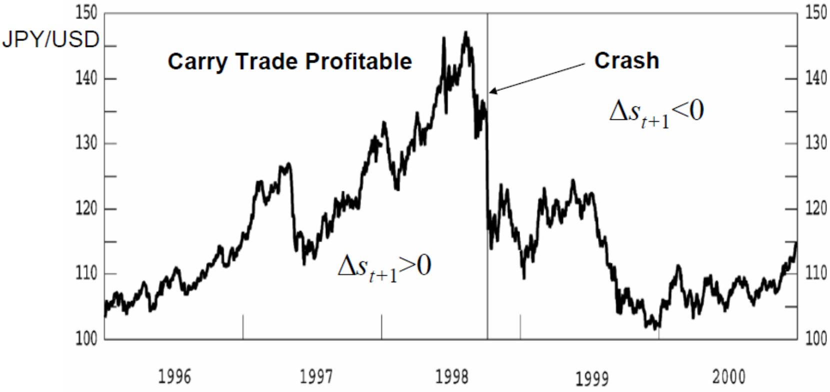
The Carry Trade: an example

- Suppose $i^{US} = 5\%$ and $i^{JAP} = 0\%$ per year
  1. Borrow 1000 JPY, convert to \$ and buy US bonds
  2. Receive US return one year later, convert back to JPY
  3. Pay back 1000 JPY, keep profit of 50 JPY
- This example assumes that the exchange rate remains unchanged
- If the Dollar depreciates by less than 5%, profit will be positive. If the Dollar appreciates, profit will exceed 50 JPY (ie greater than 5%).
- If UIP held the average profit from this strategy would be zero, because UIP predicts a 5% depreciation in the Dollar

The Carry Trade: evidence

- Contrary to the predictions of UIP, the Carry Trade exists and can make substantial profits over long horizons
- Burnside et al. (2008) report an average return from a 20-currency Carry Trade from 1976 to 2009 of 4.8% per Dollar invested
- Moreover, they find evidence that the excess return from the Carry Trade is not a conventional risk premium
- Instead, they argue that it represents compensation for the 'Peso problem' – low probability events events that occur out of sample
- The Peso event is associated with a moderate negative Carry Trade return at a time when consumption is already very low

The Carry Trade unwinding (1996-2000)



Source: Brunnermeier et al. (2008)

Equilibrium exchange rates

- We will focus for the remainder of the lecture on real exchange rates
- In practice, real exchange rates are calculated using different prices:
  1. Consumer Price Index
  2. Producer Price Index
  3. Terms of Trade
  4. Relative Unit Labour Costs

Equilibrium exchange rates

- The bilateral real exchange rate is given by $Q = \frac{SP^*}{P}$
- The real effective exchange rate is related to a country's bilateral real exchange rates with its trading partners
- Each real exchange rate is weighted by the trade share α_j of the foreign country with the home economy
- Suppose the home country trades with N different countries

Equilibrium exchange rates

- The real effective exchange rate is then

$$\boxed{REER = \sum_{j=1}^{N} \alpha_j \frac{\widetilde{S}_j P}{P_j^*}}$$

where

$$\begin{aligned} P_j^* &= \text{foreign price level in country } j \\ \widetilde{S}_j &= \text{bilateral nominal exchange rate with country } j \end{aligned}$$

- $\widetilde{S}_j$ is defined as the number of foreign currency units per unit of home currency. This means that a *rise* in $\widetilde{S}$ is an *appreciation*.
- REERs are expressed as index numbers, with a rise above 100 being an appreciation and a fall below 100 being a depreciation

Equilibrium exchange rates

- UIP is a simple exchange rate concept that is helpful for thinking about equilibrium exchange rates
- In real terms we can express UIP in the form

$$\boxed{r = r^* + \Delta q^e}$$

where

$$r = \text{real interest rate on domestic bonds}$$
$$r^* = \text{real interest rate on foreign bonds}$$
$$\Delta q^e = \text{expected rate of depreciation of the real exchange rate}$$

- If there is a risk premium, then

$$\boxed{r = r^* + \Delta q^e + RP}$$

Equilibrium exchange rates

- Since $\Delta q^e = q^e - q$, the last equation implies that

$$q = -(r - r^*) + q^e + RP$$

- This does not amount to an equilibrium model of real exchange rates
- The reason is that we need to know what determines real exchange rate expectations – ie the q^e term
- But this equation does provide us with an excellent starting point!

Models of equilibrium exchange rates

- These models aim to explain real exchange rates in terms of different sets of explanatory variables:

$$q = \beta' Z + \theta' T + \varepsilon$$

where

$$q = \text{log real effective exchange rate}$$
$$Z = \text{vector of economic fundamentals}$$
$$T = \text{vector of transitory factors (including dynamic effects)}$$
$$\varepsilon = \text{random disturbance term}$$

- The idea with these models is to say something useful about how close real exchange rates are to their equilibrium levels

Behavioural Equilibrium Exchange Rates (BEER)

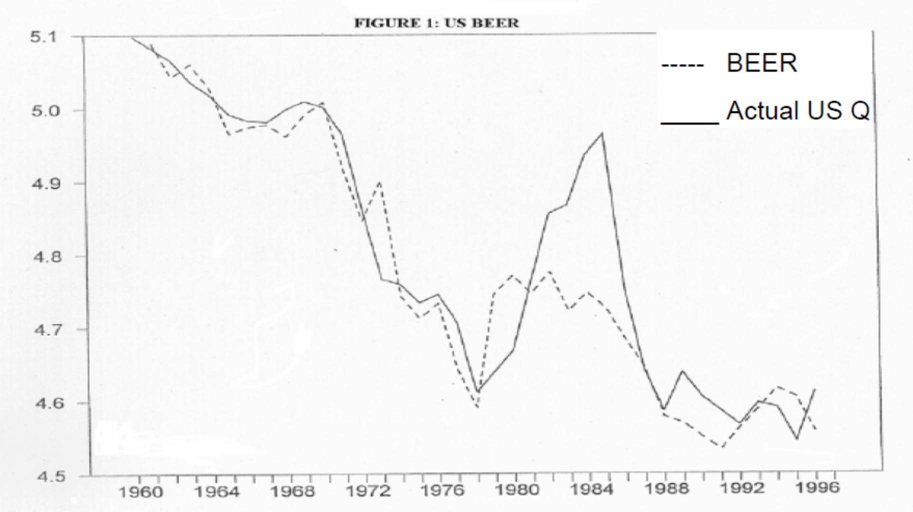
- The BEER model builds on the equation: $q = -(r - r^*) + q^e + RP$
- If we assume q^e depends on long run economic fundamentals, then real exchange rates are related to
  1. An equilibrium component $\overline{q}$
  2. A short run deviation due to real interest rates and the risk premium
- Once we have chosen some long run economic fundamentals and collected the data, we can estimate the model!
- A standard approach is to use the Johansen cointegration method

Clark and MacDonald (1998)

- CM assume that the risk premium depends on government debt ratios
- The variables they choose as long run economic fundamentals are:
  1. Net foreign assets
  2. Terms of trade
  3. Relative price of traded to non-traded goods
- So the model they estimate is of the form

$$q_t = f\left[r - r^*, \, nfa, \, tot, \, dtnt, \, debt\right]$$

Clark and MacDonald's (1998) US BEER



Short run models

Capital Enhanced Equilibrium Exchange Rates (CHEER)

- Another short run model is CHEER, which combines PPP and UIP
- It is based on the assumption that the real exchange rate will be constant in the long run when interest differentials are zero
- In other words, it assumes PPP will hold in the long run
- This approach also uses the cointegration methodology of Johansen

Medium run models – underlying balance

- These models aim to explain medium run real exchange rates
- The central idea is that in the medium run the economy will be in internal and external balance. This is not a requirement in the short run models we discussed above.
- In underlying balance models, the exchange rate is consistent with fundamentals being at trend values
- But these values may be adjusting towards a long run equilibrium as net foreign assets can vary

Medium run models – underlying balance

- **Internal balance**
  1. Demand is at supply potential
  2. The economy is running at normal capacity

- **External balance**
  1. The current account is at a sustainable level
  2. In other words, the gap between savings and investment is sustainable
  3. The current account can change, because $CA =$ change in NFA

Medium run models – underlying balance

- The best known underlying balance model is the FEER – ie Fundamental Equilibrium Exchange Rates
- There are two basic approaches to estimating FEERs:
  1. Take an estimated model, impose internal and external balance, then solve for the implied real exchange rate
  2. Set the current account equation at a sustainable level, which is assumed to be given by a sustainable capital account. Then solve for the real exchange rate.
- Unfortunately, it is very difficult to define 'sustainable' levels of the current account in practice

Long run models

- Even in long run models, net foreign assets may not be equilibrium
- In other words, asset stocks may still be adjusting
- However, these models go beyond medium run models because they calculate **permanent changes** in the real exchange rate
- In other words, they assume the long run equilibrium exchange rate can vary, in contrast to PPP

Permanent Equilibrium Exchange Rates (PEER)

- In the BEER approach, economic fundamentals do not need to be at equilibrium
- PEER separates the BEER into permanent and transitory components (Clark and MacDonald, 2000)
- Since there is no attempt to directly measure long run levels for economic fundamentals, this is a statistical definition of equilibrium rather than an economic one

Next time...

- We will study the Global Financial Crisis, including its causes, consequences and policy implications

- **Advance reading:**

  1. IMF 2009: Lessons of the Global Crisis for Macroeconomic Policy.