Advanced Macroeconomics
7. Exchange Rates, Interest Rates and Expectations

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Exchange Rates

- We have talked a lot about interest rates but have not yet focused on another important aspect of monetary policy: Exchange rates.
- Why do exchange rates matter? Consider the Euro-Pound exchange rate, so that €1 = £X.
- Suppose X goes up, so the Euro is worth more. What happens to exports and imports?
  1. *Exports*: For each pound in sterling revenues that an Irish firm earns, they now get less revenue in euros unless they increase their UK price. Exporting will be less profitable and total exports will decline. Alternatively, if they decide to try to maintain profit by increasing their price in the UK, this will reduce demand, so exports will still decline.
  2. *Imports*: UK firms will get more sterling revenues from exporting to Ireland at the same prices, so they may decide to do more of this. Alternatively, they may decide to lower their euro-denominated prices in Ireland and increase their market share while still getting the same sterling revenue per unit. Either way, imports will increase.

Exchange Rates and Economic Growth

- While an increase in the value of the Euro may sound like a good thing for Ireland, it tends to reduce exports, increase imports, and thus reduce Irish GDP.
- In contrast, a depreciation of the currency boosts exports and has a positive effect on economic growth.
- For these reasons, a depreciation of the currency is often welcome in a recession and the absence of this tool when the exchange rate is fixed is often pointed to as a downside of such regimes.
- That said, exchange rate depreciation has its downsides also:
    1. *Inflation*: Depreciation tends to make imports more expensive and so add to inflation. This is one reason why central bankers tend to say they favour a strong currency. For small open economies that import a lot, the inflationary effects of depreciation are much bigger.
    2. *Temporary Boost*: The boost to growth is temporary. Over time, the increase in import prices may feed through to higher wages. This gradually erodes the competitive benefits from devaluation.

Investment with Free Movement of Capital

- Suppose money can flow easily between the US and the Euro area.
- Suppose also that investors can buy either US or European risk-free one-period bonds. European bonds have an interest rate of i_t^E and US bonds have an interest rate of i_t^{US}.
- Let e_t represent the amount of dollars that can be obtained for one Euro.
- Consider an investor that spends \$1 today on Euro-denominated bonds and then exchanges the return from their investment back into dollars next period. They expect to have $\$\left(1+i_t^E\right)\left(\frac{E_t e_{t+1}}{e_t}\right)$ next period.
- If US investors are risk-neutral, then they will be indifferent between US and European bonds if

$$\left(1+i_t^E\right)\left(\frac{E_t e_{t+1}}{e_t}\right)=1+i_t^{US}$$

- Can also be written as

$$\left(1+i_t^E\right)\left(1+\frac{E_t e_{t+1}-e_t}{e_t}\right)=1+i_t^{US}$$

Uncovered Interest Parity

- The last equation can be re-written as

$$1 + i_t^E + \frac{E_t e_{t+1} - e_t}{e_t} + i_t^E \left(\frac{E_t e_{t+1} - e_t}{e_t} \right) = 1 + i_t^{US}$$

- Subtracting the 1 from each side, we get

$$i_t^E + \frac{E_t e_{t+1} - e_t}{e_t} + i_t^E \left(\frac{E_t e_{t+1} - e_t}{e_t} \right) = i_t^{US}$$

- Since both i_t^E and $\frac{E_t e_{t+1} - e_t}{e_t}$ are going to be relatively small, the product of them will usually be close to zero, so the condition for the investor to be indifferent between the two investment strategies is

$$i_t^E + \frac{E_t e_{t+1} - e_t}{e_t} \approx i_t^{US}$$

- This condition—which says that the foreign interest rate plus the expected percentage change in the value of the foreign currency should equal the domestic interest rate—is known as the Uncovered Interest Parity condition.
- If European interest rates are lower than US rates, then the Euro must be expected to appreciate.

Why Would UIP Hold?

- Why would be expect investors to be indifferent between US and European bonds?
- Suppose it turned out that the European bonds offered a better deal than the US bonds.
- If there is perfect capital mobility, then this would mean that there would be a rush for investors to purchase European bonds rather than US bonds.
- European institutions who borrow via selling these bonds (governments, highly rated corporations) would figure out that they could borrow at a lower interest rate and still find investors willing to buy their bonds as well as US bonds.
- By this logic, deviations from UIP should be temporary with borrowers adjusting the interest rates on their bonds to ensure that investors are indifferent between various international investments.

The Trilemma of International Finance

- The logic of the UIP relationship is that it is not possible to have all three of the following:
  1. Free capital mobility (money moving freely in and out of the country).
  2. A fixed exchange rate.
  3. Independent monetary policy.
- The so-called "Trilemma" of International Finance states that you can have any two, but not the third:
  1. You can have free capital mobility and a fixed exchange rate (so that $E_t e_{t+1} = e_t$) but then your interest rates must equal those of the area you have fixed exchange rates against ($i_t^{US} = i_t^E$) e.g. Ireland.
  2. You can have free capital mobility and set your own monetary policy ($i_t^{US} \neq i_t^E$) but then your exchange rate cannot simply be fixed (so that $E_t e_{t+1} \neq e_t$) e.g. the UK.
  3. You can set your own monetary policy and fix your exchange rate against another country, but then you must intervene in capital markets to prevent people talking advantage of investment arbitrage opportunities, e.g. China.

Flexible Exchange Rates Under Capital Mobility

- Condition for expected return on US and Euro investments to be the same was

$$\left(1+i_t^E\right)\left(\frac{E_t e_{t+1}}{e_t}\right)=1+i_t^{US}$$

- Take logs, it becomes

$$\log\left(1+i_t^E\right)+E_t\log e_{t+1}-\log e_t=\log\left(1+i_t^{US}\right)$$

- This is a linear stochastic difference equation describing the properties of the log of the exchange rate. Re-arranged to be in our more familiar format as

$$\log e_t=\log\left(1+i_t^E\right)-\log\left(1+i_t^{US}\right)+E_t\log e_{t+1}$$

- Apply the repeated substitution technique to this equation we get

$$\log e_t=\sum_{k=0}^{\infty}E_t\left[\log\left(1+i_{t+k}^E\right)-\log\left(1+i_{t+k}^{US}\right)\right]$$

Not a Unique Solution

- The solution just derived

$$\log e_t = \sum_{k=0}^{\infty} E_t \left[\log \left(1 + i_{t+k}^{E} \right) - \log \left(1 + i_{t+k}^{US} \right) \right]$$

  is not the only possible solution.

- For any arbitrary number $\log \bar{e}$ we could re-arrange third equation from previous slide as

$$\log e_t - \log \bar{e} = \log \left(1 + i_t^{E} \right) - \log \left(1 + i_t^{US} \right) + E_t \log e_{t+1} - \log \bar{e}$$

- So, the general solution is

$$\log e_t = \log \bar{e} + \sum_{k=0}^{\infty} E_t \left[\log \left(1 + i_{t+k}^{E} \right) - \log \left(1 + i_{t+k}^{US} \right) \right]$$

- Because the natural log function has the property that $\log (1 + x) \approx x$, we can simplify this to read

$$\log e_t = \log \bar{e} + \sum_{k=0}^{\infty} E_t \left(i_{t+k}^{E} - i_{t+k}^{US} \right)$$

Properties of this Solution

- UIP tells us something about the *dynamics* of the exchange rate but it does not make definitive predictions about the level an exchange rate should be at, i.e. it does not pin down a unique value of $\bar{e}$.
- The reason this case is different from previous applications is that the coefficient on the future y_t variable equals one in this case, which makes the solution a bit different.
- Other theories, such as Purchasing Power Parity (the idea that exchange rates should adjust so each type of currency has equivalent purchasing power) make specific predictions for the level of the exchange rate but they don't work very well in practice.
- This unexplained $\bar{e}$ can be seen as a sort of long-run equilibrium exchange rate because this is the rate that holds when the average interest rate on European bonds in the future equals the average interest rate on US bonds.
- The model predicts that deviations from the long-run exchange rate $\bar{e}$ are determined by expectations that interest rates will differ across areas. In this example, the euro will be higher than $\bar{e}$ if people expect European interest rates to be higher in the future than US rates.

Response of Exchange Rates to Interest Rate Surprises

- Suppose in period $t-1$, Euro and US interest rates were equal to each other and expected to stay that way. Our model

$$\log e_t = \log \bar{e} + \sum_{k=0}^{\infty} E_t \left(i^E_{t+k} - i^{US}_{t+k} \right)$$

  implies that under these circumstances we would have $\log e_{t-1} = \log \bar{e}$.

- Now suppose that, in period t, Euro interest rates unexpectedly went above US interest rates just for one period. What would happen?
- The Euro must end up back at $\bar{e}$ (because interest rates in the two areas are going to equal each other after period t) and the Euro must also be expected to depreciate (because of the higher current interest rate in Euro).
- So, in response to the surprise temporary increase in European interest rates, the Euro immediately jumps upwards and then depreciates back to $\bar{e}$. This conforms with our intuition that higher European interest rates should make the Euro more attractive.

UIP and Exchange Rate Volatility

- Before the widespread introduction of flexible exchange rates in the 1970s, its advocates predicted they would change very little over time.
- The truth has been the opposite: Exchange rates change by very large amounts on a daily, weekly, monthly basis.
- The UIP model helps to explain why. Using our equation for the level of exchange rates, we can derive the change as

$$\begin{aligned}
\Delta \log e_t &= \sum_{k=0}^{\infty} E_t \left(i_{t+k}^{E} - i_{t+k}^{US} \right) - \sum_{k=-1}^{\infty} E_{t-1} \left(i_{t+k}^{E} - i_{t+k}^{US} \right) \\
&= i_{t-1}^{US} - i_{t-1}^{E} + \sum_{k=0}^{\infty} \left(E_t - E_{t-1} \right) \left(i_{t+k}^{E} - i_{t+k}^{US} \right)
\end{aligned}$$

UIP and Exchange Rate Volatility

Implications of

$$\Delta \log e_t = i_{t-1}^{US} - i_{t-1}^{E} + \sum_{k=0}^{\infty} (E_t - E_{t-1}) \left(i_{t+k}^{E} - i_{t+k}^{US} \right)$$

1. Exchange rate changes reflect not only the *expected* change due to past interest rate differentials expiring (the $i_{t-1}^{US} - i_{t-1}^{E}$ term); they also reflect *unexpected* changes in the projected path of future interest rate differentials.
2. So all information that affects expectations of future Euro-area and US interest rates feed directly into today's exchange rate.
3. For this reason, exchange rates react to all major pieces of macroeconomic news.
4. This helps explain why exchange rates are so volatile.

Exchange Rate Volatility: The Euro-Dollar Exchange Rate

Problems for the UIP Theory

- The UIP theory helps to explain a number of important aspects of the behaviour of exchange rates.
- However, often the theory does not work well. Indeed, quite commonly the theory predicts for an extended period of time that a currency depreciation should be expected, when in fact there is an appreciation, or vice versa.
- A partial explanation is that $E_t e_{t+1} - e_t$ is not the same as $e_{t+1} - e_t$. does.
- An example: The Peso problem. Sometimes interest rates in developing economies are high because markets think a large depreciation may be coming at some point. Just because it doesn't happen this period doesn't mean the expectation was unreasonable.
- But evidence also exists of more systematic errors of the UIP theory.
- Example: Japanese interest rates were well below European levels for most of the last decade. UIP predicts that the Yen should be appreciating against the Euro: In fact, the opposite happened systematically from 2001 to 2008. Many traders systematically exploited this, borrowing at low interest rates in Yen and buying Euro bonds—the so-called Yen carry trade.

The Value of the Euro Against the Yen

Things To Understand From This Topic

Things you need to understand from these notes.

1. How do changes in exchange rates affect the economy?
2. Effects over time of devaluations.
3. Uncovered interest parity.
4. The Trilemma.
5. The joint implications of predictions of UIP combined with rational expectations.
6. Why we should expect flexible exchange rates to be volatile.
7. Problems with the RE-UIP theory.