Currency markets: Section 6

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Currency swap

A

US Parent Company A wants to finance a five-year project for its European Subsidiary B which costs €40,000,000.

Company A can finance the project in the US capital market by issuing five-year bonds at 8% and convert to euros. However, then the firm is exposed to long-term exchange rate risk.

The current spot rate is \$1.30/€1.00.

Company A could also finance the project in the European capital market but because US Company A is not well-known in Europe, they can only issue five-year bonds at 7%. However, a well-known firm with the same credit worthiness can borrow at 6%.

Currency swap

X

German

Now consider a well-known ~~European~~ Parent Company X with the same credit worthiness. It has a US Subsidiary Y that needs financing ~~need~~ of \$52,000,000.

Company X can finance the project in the European capital market by issuing five-year bonds at 6% and convert to dollars. However, then the firm is exposed to long-term exchange rate risk.

Company X could also finance the project in the US capital market but because European Company X is not well-known in the US, they can only issue five-year bonds at 9%. However, a well-known firm with the same credit worthiness can borrow at 8%.

$S_0 = \$1.3/€$

Currency swap

A swap bank can deal with US Company A and ~~European~~ German Company X separately.

$S_0 = \$1.30/€1.00$

Execute a currency swap.

	US	Europe
interest rate (well-known)	8%	6%
interest rate (unknown)	9%	7%

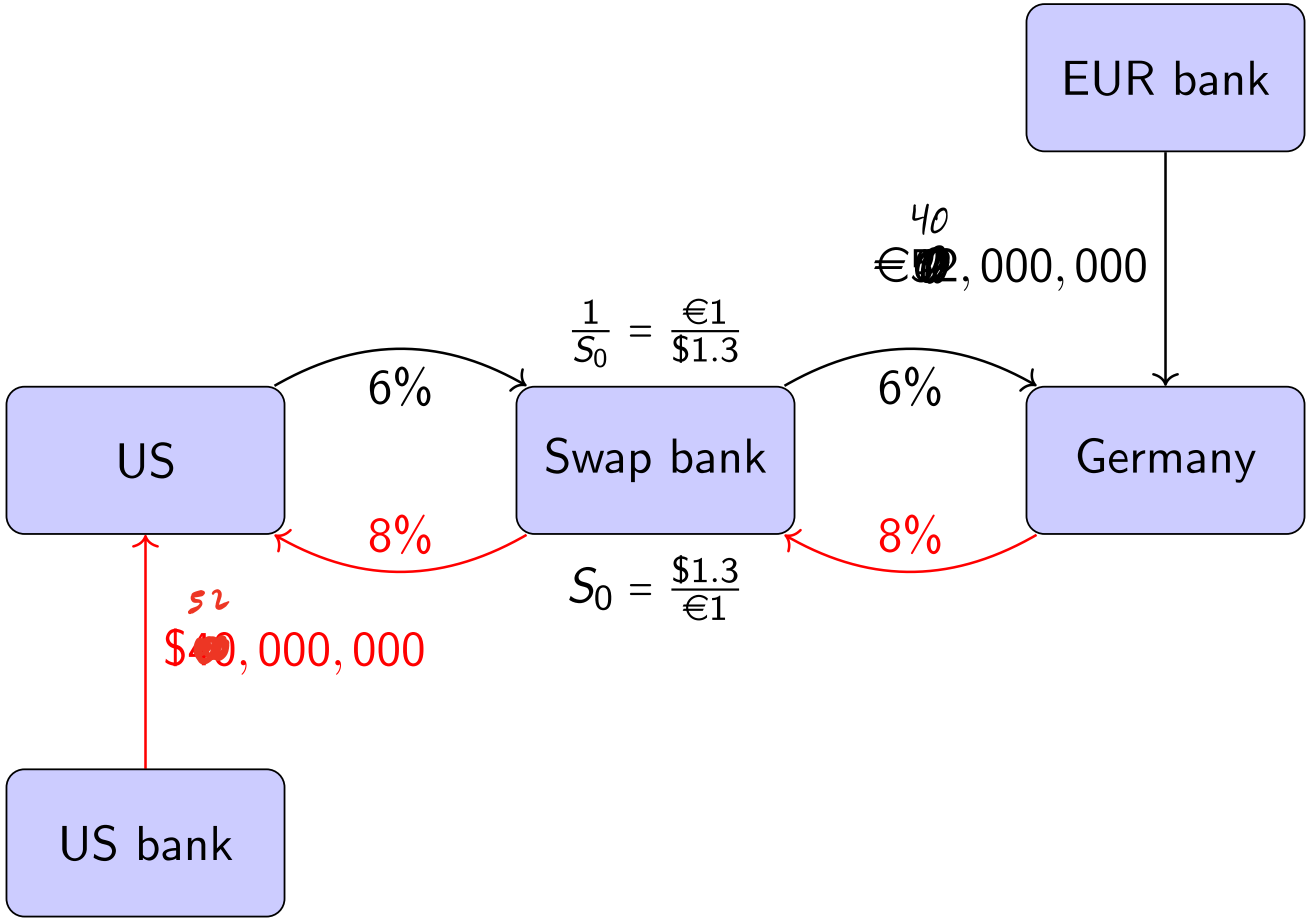
Parent companies	US	Germany
financing need	$52,000,000	€40,000,000

Currency swap

What's going on?

1. Parent companies borrow from their own respective capital markets.
2. Parent companies exchange principal amounts through the swap bank. at S_0
3. US parent company pays the 6% interest payment (€2,400,000) to the German parent company through the swap bank every year.
4. German parent company pays the 8% interest payment ($4,160,000) to the US parent company through the swap bank every year.
5. At maturity, parent companies exchange principal amounts through the swap bank to pay off bonds in the national markets.

Currency swap



Currency swap

S_0 is locked

Net cash flows

	US	Swap bank	Germany
Pays	~~8%~~ (\$)	8% (\$)	8% (\$)
	6% (€)	6% (€)	~~6%~~ (€)
Receives	~~8%~~ (\$)	8% (\$)	
		6% (€)	~~6%~~ (€)
Net	-6% (€)	0%	-8% (\$)
Savings/earnings	7% (€) - 6% (€)	0%	9% (\$) - 8% (\$)
	= 1% (€)	↑	= 1% (\$)
	€		\$

Purchasing Power Parity (PPP)

- $P_\$$ = US prices in USD.
- P_* = Country $*$ £ prices in $*$ £ currency.
- Absolute version of PPP

$$S = \frac{P_\$}{P_*}$$

- $S_{t+1} - S_t > 0$
  - $\Rightarrow$ \$ depreciation (because you need more \$ to pay for a unit of *)
- Condition relies on Law of One Price.
  - Applied internationally to a standard consumption basket.

Purchasing Power Parity (PPP)

- Consider a "rate of change" version of the relationship between goods' prices and exchange rates. Derive the relative version of PPP.
- Let's say you have an existing spot rate, and changes in the spot rate are due to changes in prices.

$$S_0 = \frac{P_\$}{P_*}$$

$$S_{t+1} = \frac{\overbrace{1+\pi_\$}^{\Delta \text{ in new US prices}}}{\underbrace{1+\pi_*}_{\Delta \text{ in new * prices}}} \cdot S_t$$

$-S_t$ $-S_t$

$$S_{t+1} - S_t = \frac{1+\pi_\$}{1+\pi_*} \cdot S_t - S_t$$

divide by S_t

$$\underbrace{\frac{S_{t+1} - S_t}{S_t}}_{e} = \frac{1+\pi_\$}{1+\pi_*} - 1 = \frac{\pi_\$ - \pi_*}{1+\pi_*}$$

$$\frac{1+\pi_\$}{1+\pi_*} - \frac{1+\pi_*}{1+\pi_*}$$

Purchasing Power Parity (PPP)

- Relative version of PPP

$$e = \frac{\pi_\$ - \pi_*}{1 + \pi_*} \approx \pi_\$ - \pi_*$$

- $e > 0$
  - $\Rightarrow$ \$ depreciation (because you need more \$ to pay for a unit of *)
  - $\Rightarrow$ positive inflation difference ($\pi_\$ - \pi*$) to keep exchange rate constant on PPP.
- In expectation,

$$E\left[\pi_\$ - \pi_*\right] \approx \frac{E_t\left[S_{t+1}\right] - S_t}{S_t}. = E[e]$$

- Is it possible for relative PPP to hold while absolute PPP does not hold?

$S_t = \frac{P_\$}{P_*}$

Purchasing Power Parity (PPP)

- When the relative version of PPP holds

$$e = \frac{1+\pi_\$}{1+\pi_*} - 1 \Leftrightarrow e + 1 = \frac{1+\pi_\$}{1+\pi_*} \Leftrightarrow 1 = \frac{1+\pi_\$}{(1+e)(1+\pi_*)}.$$

- What if there are deviations from PPP such that the relative version of PPP no longer holds?

$$1 \neq \frac{1+\pi_\$}{(1+e)(1+\pi_*)}$$

- We define the real exchange rate as

$$q = \frac{1+\pi_\$}{(1+e)(1+\pi_*)}.$$

Real exchange rate

- q relates the evolution in prices to the change in the spot rate

$$q = \frac{1+\pi_{\$}}{(1+e)(1+\pi_*)} = \frac{\frac{1+\pi_{\$}}{1+\pi_*}}{1+e}$$

- If $q > 1$,
  - Spot exchange rate fails to decrease enough to account for the relatively high domestic ($) inflation. relative to π_*
  - Domestic ($) competitiveness falls.
  - Imagine an extreme situation where inflation is rapidly rising and the exchange rate fails to change fast enough ☹
- If $q < 1$,
  - Spot exchange rate fails to increase enough to account for the relatively low domestic ($) inflation.
  - Domestic ($) competitiveness rises.

Why do we want relative PPP to hold in the long run?

- Why do we observe that relative PPP holds in the long run?

Uncovered Interest Parity (UIP)

$$i_{\$} - i_{*} = \frac{F_t - S_t}{S_t}$$

- Recall the CIP condition $(1+i_{\$}) = \frac{F_t}{S_t}(1+i_*) \Rightarrow i_{\$} - i_* = \frac{F_t - S_t}{S_t}(1+i_*)$.
- Now consider an *unbiased forward rate* in expectation given today's information I_t

$$F_t = E\left[S_{t+1} | I_t\right].$$

- Substitution yields

$$\begin{aligned} i_{\$} - i_* &= \frac{E\left[S_{t+1}|I_t\right] - S_t}{S_t}(1+i_*) \\ &\approx \frac{E\left[S_{t+1}|I_t\right] - S_t}{S_t} \end{aligned}$$

Uncovered Interest Parity (UIP)

- If there exists an interest rate difference in an efficient market, the currency that has a higher interest rate is expected to give it back.
- Approximately,

$$i_{\$} - i_{*} \approx \frac{E_t\left[S_{t+1}\right] - S_t}{S_t} = E[e].$$

- If the interest rate difference is negative, S_{t+1} is expected to decrease meaning that it takes fewer \$ to buy $*$ or the \$ is expected to appreciate.

Uncovered Interest Parity (UIP)

$$i_{\$} - i_{*} \approx \frac{E_t\left[S_{t+1}\right] - S_t}{S_t} = E[e].$$

- This is an equilibrium condition.
  - Relies on the assumption that capital markets are efficient.
  - If not true, interest rates may be set inefficiently.
- Does not hold today due to transaction costs, evolving global demand for *certain* currencies, and capital controls.

Carry trade

- Execute a trade where you buy a high yielding currency and fund it with a low yielding currency.
- Can be self-financing.
- Profitable if

$$i_{\$} - i_{*} > \frac{E_t\left[S_{t+1}\right] - S_t}{S_t}$$

- However, the carry trade is exposed to exchange rate risk.
    - Imagine that you borrow from a country with 2% interest rate with domestic currency X and invest in a bond from a country with 4% interest rate with foreign currency Y.
    - If currency Y depreciates *more than expected* according to UIP, then you would have been better off by simply investing domestically with 2% interest.
- Useful to make good predictions on S_{t+1} here!


Lend at low-yielding domestic interest rate
Buy a high-yielding currency and fund it with a low-yielding currency given
$i_\$ - i_* > \frac{E[S_{t+1}] - S_t}{S_t}$

A few more terms

$\frac{F_t - S_t}{S_t}$ $\frac{E[S_{t+1}] - S_t}{S_t}$

$i_\$ - i_*$

$\pi_\$ - \pi_*$

- Unbiased forward rate (UFR): $F_{t+1} = E_t[S_{t+1}]$.
  - Forward expectations parity (FEP): $E[e] = \frac{F-S}{S}$.
- Real interest parity (RIP): $i_\$ - i_€ = \pi_\$ - \pi_€$.
  - Fisherian equation (FE):

nominal rate real rate

$$i_\$ = \rho_\$ + E[\pi_\$] + \rho_\$ E[\pi_\$] \approx \rho_\$ + E[\pi_\$]$$

  - FE $\Rightarrow$ RIP if $\rho_\$ = \rho_€$, i.e., the real interest rates equal
- Forward-PPP (FPPP): Inflation differential equals the forward premium/discount.

$i_\$ = \rho_\$ + E[\pi_\$]$

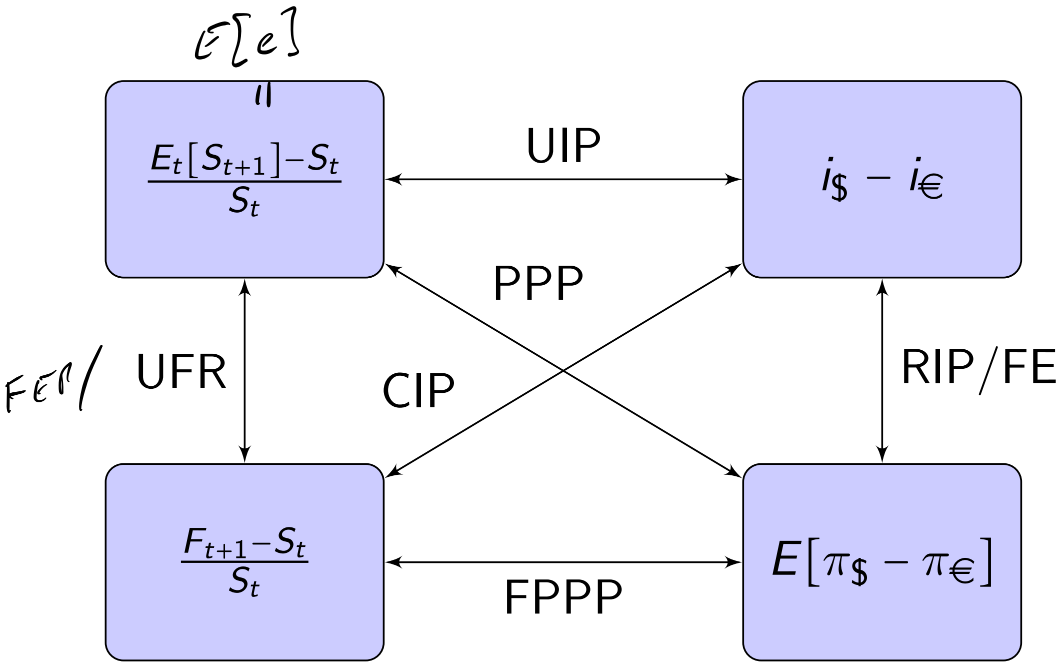
$\Rightarrow \rho_\$ = i_\$ - E[\pi_\$]$

$\rho_* = i_* - E[\pi_*]$

if $\rho_\$ = \rho_* \Rightarrow i_\$ - E[\pi_\$] = i_* - E[\pi_*]$

$i_\$ - i_* = E[\pi_\$ - \pi_*]$

Connecting the dots...



True if
parity
Conditions
hold

Parity conditions summary

- CIP - arbitrage condition.
- UIP - equilibrium condition.
- PPP - Law of One Price [across borders].
- Parity conditions are linked, but some fail hold in reality.
  - UIP.
  - Relative PPP in the short run.
- Extreme deviations from the parity conditions are concerning.

Pset 4 hints

- Read investing with forward markets and CIP slides from last week.
- Go through currency swap example.
- Forward spread: $\frac{F-S}{S}$.
- Draw a picture (or several)!