Forward Foreign Exchange

- Concept of exchange rate risk or exposure
  - Hedging: Reducing exposure to exchange rate risk
  - Speculation: Increasing exposure to exchange rate risk

- Using the forward market to hedge

- Using the forward market to speculate

- “Covered” international financial investment
  - Using the forward rate to eliminate FX risk

- “Uncovered” international financial investment
  - Doing without the forward market and taking your chances

- Covered Interest Parity & Interest Rate Arbitrage
  - Linking the spot, forward, and money market interest rates
Sources of Exposure to FX Risk

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>£1,000,000</td>
<td>¥107,000,000</td>
</tr>
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</table>

- Having an asset or liability (A/L) position in a foreign currency leads to an exposure.
- Why? $/£ and ¥/$ exchange rates may change.
- What types of Assets and Liabilities?
  - Cash, bank deposits/loans, stocks, bonds, any accounts receivable (A/R) or accounts payable (A/P).
- If elasticity of $ value (\(\% \Delta \text{Value} / \% \Delta \text{FX rate}\)) is non-zero, then exposure exists.
Types of Exposure to FX Risk

✧ Suppose you are American and value your wealth in US$ Terms
  › Direct: You have assets in £; or you have liabilities in ¥
  › Indirect: You own shares in IBM, that has A/L in £ and ¥
  › “More indirect”: IBM has only US assets and operations, but competes with Toshiba, so IBM effected by $/¥ rate

✧ Other international risks matter
  › Counterparty risk: Risk that counterparty to an FX contract will default and not deliver their leg of the transaction
  › Country risk: Transfer of funds blocked (temporarily or permanently), expropriated without fair compensation, taxed
## Hedging a Foreign Currency Asset

To hedge a foreign currency asset position, sell forward an amount equal to the foreign currency asset (including dividends, coupons, and interest if applicable). The value of the asset is locked-in (hedged) in US$ terms.

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<tr>
<td>£1,000,000</td>
<td></td>
</tr>
<tr>
<td>A/R $1,600,000</td>
<td>A/P £1,000,000</td>
</tr>
<tr>
<td>12/31/99</td>
<td>12/31/99</td>
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Hedging a Foreign Currency Liability

To hedge a foreign currency liability position, buy forward an amount equal to the foreign currency liability (including dividends, coupons, and interest if applicable).

The value of the liability is locked-in (hedged) in US$ terms.

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Speculating on FX Rate Changes

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- Having an asset or liability (A/L) position in a foreign currency gives an exposure and a speculative position.

- **Asset positions in £:**
  - Gain US$ value as £ appreciates ($1.60 ↑ $1.65/ £)
  - Lose US$ value as £ depreciates ($1.60 ↓ $1.55/ £)

- **Liability positions in ¥:**
  - Gain US$ value as ¥ depreciates (¥ 107 ↑ ¥ 110/ $)
  - Lose US$ value as ¥ appreciates (¥ 107 ↓ ¥ 103/ $)
Covered International Investment (1 of 2)

- Consider a 3-month investment of $1 in a US security
  - Ending value is $1 \( (1 + i_{US}/4) \)
- Consider an investment of $1 in a UK security on a covered basis
  - Buy £ at spot rate (S): $1/S
  - Take £ and invest in 3-month UK security: \( (1 + i_{UK}/4) \)
  - Sell all proceeds (principal + interest) at today’s 3-month forward rate (F): \( (1 + i_{UK}/4) \times F \)
Assume: $S=1.50/\£, i_{US}=6\%, i_{UK}=12\%, F=1.47/\£$

» US security: $1 \times (1+i_{US}/4) = 1 \times (1+.06/4) = 1.015$

» Covered UK security:
  
  \[
  \frac{1}{S} \times (1+i_{UK}/4) \times F = \frac{1}{1.5} \times (1+.12/4) \times 1.47 = 1.0094
  \]

» Prefer US security over UK security

Now assume: $S=1.50/\£, i_{US}=6\%, i_{UK}=12\%$ as before but let $F=1.48/\£$

» US security: $1 \times (1+i_{US}/4) = 1 \times (1+.06/4) = 1.015$ [no change]

» Covered UK security:
  
  \[
  \frac{1}{S} \times (1+i_{UK}/4) \times F = \frac{1}{1.5} \times (1+.12/4) \times 1.48 = 1.0163
  \]

» Prefer UK security over US security

» Risks of UK investment: Counterparty risks, forward contract default, exchange controls, … but not FX risk.
Covered Interest Parity

- With one forward rate (F=$1.47/£), US is preferred to UK
- With another forward rate (F=$1.48/£), UK is preferred to US
- What forward rate makes you indifferent between US and UK?
  - $1 \left(1 + \frac{i_{US}}{4}\right) = \frac{1}{S} \times \left(1 + \frac{i_{UK}}{4}\right) \times F^*$
  - $F^* = S \times \left(1 + \frac{i_{US}}{4}\right) / \left(1 + \frac{i_{UK}}{4}\right)$
  - $F^* = $1.50 \times (1.015) / (1.03) = $1.4782 / £$
  - $F^* = $ the forward rate that establishes covered interest parity

- When covered interest parity holds, the return on covered foreign investment = return on domestic investment (controlling for maturity, credit risk, political risk)
Covered Interest Arbitrage

The **covered interest differential** is the incentive to invest in the foreign security versus the domestic CD:

\[ CD = \frac{F}{S} \left(1 + i_{UK}\right) - \left(1 + i_{US}\right) \]

» CAUTION! The interest rate is the rate per period that matches the period of the forward contract.

**If the CD favors UK, then profit available from covered interest arbitrage flows out of \$ and into £**

1. Sell US security, 2. Buy £ spot,
3. Buy UK security, 4. Sell £ forward [to cover]

**If the CD favors US, then profit available from covered interest arbitrage flows out of £ and into \$**

1. Sell UK security, 2. Sell £ spot,
The Interest Parity Line

- **The interest parity line:** The locus of points along which forward premium and interest differential are equal and there is no incentive for covered interest arbitrage.

  - When \( CD = 0 \), \( \frac{F}{S} \left(1+i_{UK}\right) - \left(1+i_{US}\right) = 0 \) or
    - \( \frac{F}{S} = \frac{1+i_{US}}{1+i_{UK}} \)
    - \( F/S - 1 = \frac{1+i_{US}}{1+i_{UK}} - 1 \)
    - \( \frac{(F-S)}{S} = \frac{i_{US} - i_{UK}}{1+i_{UK}} \)
    - Forward premium = Interest differential

- Interest parity line is equilibrium among spot, forward, and money market interest rates
  - Assumes no transaction costs, taxes, or default risks
The Interest Rate Parity Line
Equilibrium and Disequilibrium Points

Forward Premium: \((F-S)/S\)

\((i,\$ - i,\text{foreign})/(1 + i,\text{foreign})\)

Capital Outflows
\($\) to Foreign Currency

Capital Inflows
Foreign Currency to \($\)
Uncovered International Investment (1 of 2)

- Consider a 3-month investment of $1 in a US security
  » Ending value is $1 \(1+i_{US}/4\)

- Consider an investment of $1 in a UK security on an uncovered basis
  » Buy £ at spot rate \(S_t\): $1/S_t
  » Take £ and invest in 3-month UK security: $(1+i_{UK}/4)
  » WAIT … DO NOTHING
  » Sell all proceeds (principal + interest) at the future spot rate that prevails 3-months later: $(1+i_{UK}/4) \times S_{t+3}$

- Note well: At the time \(t\) of the uncovered investment, \(S_{t+3}\) is unknown. The investor can form an expectation of \(S_{t+3}\) but the actual rate could differ.
Uncovered International Investment (2 of 2)

- The **expected uncovered interest differential** is the incentive to invest in the foreign security versus the domestic based on your expectation \((S^*_{t+3})\) of the future spot rate:

  \[
  \text{EUD} = \frac{S^*_{t+3}}{S_t} (1+i_{UK}) - (1+i_{US})
  \]

  and this is approximately equal to

  \[
  (S^*_{t+3}/S_t) - 1 + (i_{UK} - i_{US})
  \]

  or

  \[
  \text{EUD} = \text{Expected £ appreciation} + (i_{UK} - i_{US})
  \]

- Uncovered international investment is favorable when the interest differential exceeds the rate of foreign currency depreciation.

- Uncovered interest parity holds when average EUD=0
Empirical Evidence on Covered and Uncovered Interest Parity

**Covered Interest Parity:** Does $F = S \frac{(1+i_{US})}{(1+i_{UK})}$?
- Data strongly support this parity relationship
- Using $F$, $S$, and Eurocurrency (offshore) interest rates, most deviations from parity (CD) are small (< transaction costs)
- Exceptions: Currency pairs and time periods when there is a risk of capital controls, or barrier to doing the arbitrage

**Uncovered Interest Parity:** Is average $EUD=0$?
- Data are mixed: Some average $\rightarrow 0$; some average $> 0$
- Need many sample observations, cannot observe $EUD$
- Could be that investors need extra return (a “risk premium”) to take on uncovered international investment
- Could be that investors make consistent errors, and FX market is inefficient
Summary on Forward Exchange and International Investment

- Open A/L foreign currency positions lead to FX risk
- Hedging can be accomplished by matching A/L positions on a currency by currency basis
- Speculation implies an unbalanced FX position, whose value varies with the FX rate
- Covered international investment attempts to eliminate (or hedge) the FX risk in foreign investment
- Uncovered international investment exposes the investor to a speculative FX investment
- The evidence strongly supports covered interest parity for pricing; however the data on uncovered interest parity are more mixed and difficult to interpret