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>
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</thead>
<tbody>
<tr>
<td>£1,000,000</td>
<td>¥107,000,000</td>
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- 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 ($\Delta$Value / $\Delta$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>A/R $1,600,000 on 12/31/99</td>
<td>A/P £1,000,000 on 12/31/99</td>
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</table>
**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.

<table>
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<th>Assets</th>
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<td>A/R ¥107,000,000 on 12/31/99</td>
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**Speculating on FX Rate Changes**

- 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/ $)
Consider a 3-month investment of $1 in a US security

- Ending value is $1 \left(1 + \frac{i_{US}}{4}\right)

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: \($1/S \times (1+i_{UK}/4)\)
- Sell all proceeds (principal + interest) at today’s 3-month forward rate (F): \($1/S \times (1+i_{UK}/4) \times F\)

Assume: \(S=\$1.50/£, i_{US}=6\%, i_{UK}=12\%, F=\$1.47/£\)

- US security: $1 \left(1 + \frac{i_{US}}{4}\right) = $1 \left(1 + \frac{0.06}{4}\right) = $1.015
- Covered UK security: \($1/S \times (1+i_{UK}/4) \times F = (\$1/1.5) \times (1+0.12/4) \times 1.47 = 1.0094\)

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 \left(1 + \frac{i_{US}}{4}\right) = $1 \left(1 + \frac{0.06}{4}\right) = $1.015 [no change]
- Covered UK security: \($1/S \times (1+i_{UK}/4) \times F = (\$1/1.5) \times (1+0.12/4) \times 1.48 = 1.0163\)

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?
  » \( $1 \left( 1 + i_{US}/4 \right) = \left( $1 / S \right) \times \left( 1 + i_{UK}/4 \right) \times F' \)
  » \( F' = S \times \left( 1 + i_{US}/4 \right) / \left( 1 + i_{UK}/4 \right) \)
  » \( F' = $1.50 \times (1.015) / (1.03) = $1.4782 / £ \)
  » \( F' \) is 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
  \[ CD = F/S \left( 1 + i_{UK} \right) - \left( 1 + i_{US} \right) \]
  » 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,
  (3) Buy US security, (4) Buy £ forward [to cover]
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, \( F/S \cdot (1+i_{UK}) - (1+i_{US}) = 0 \)

- \( F/S = (1+i_{US}) / (1+i_{UK}) \)
- \( F/S - 1 = (1+i_{US}) / (1+i_{UK}) - 1 \)
- \( (F-S)/S = (i_{US} - i_{UK}) / (1+i_{UK}) \)
- 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

The graph illustrates the relationship between the forward premium and the interest rate differential. Points A, A', B, and B' represent equilibrium and disequilibrium conditions, respectively, according to the interest parity line equation.
**Uncovered International Investment (1 of 2)**

- Consider a 3-month investment of $1 in a US security
  - Ending value is $1 \left(1 + \frac{i_{US}}{4}\right)
- 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: \(\left(\frac{1}{S_t}\right) \times \left(1 + \frac{i_{UK}}{4}\right)\)
  - WAIT … DO NOTHING
  - Sell all proceeds (principal + interest) at the future spot rate that prevails 3-months later: \(\left(\frac{1}{S_t}\right) \times \left(1 + \frac{i_{UK}}{4}\right) \times S_{t+3}\)
- 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:
  \[
  \text{EUD} = \frac{S_{t+3}^*}{S_t} \left(1 + \frac{i_{UK}}{4}\right) - \left(1 + \frac{i_{US}}{4}\right)
  \]
  and this is approximately equal to
  \[
  \left(\frac{S_{t+3}^*}{S_t}\right) - 1 + \left(\frac{i_{UK}}{2}\right) - \frac{i_{US}}{2}
  \]
  or
  \[
  \text{EUD} = \text{Expected £ appreciation} + \left(\frac{i_{UK}}{2}\right) - \frac{i_{US}}{2}
  \]
- 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