

# FOREIGN EXCHANGE RISK

FINANCIAL INSTITUTIONS MANAGEMENT  
KIMEP

# AGENDA: FOREX RISK

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- Sources of foreign exchange risk and FX trading activities;
- FX risk and hedging: futures, forwards, swaps
- Estimation of Basis risk
- Interest rate Parity Theorem

# Sources of FX Risk

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- Spot positions denominated in foreign currency
- Forward positions denominated in foreign currency
- **Net exposure = (FX assets - FX liabilities) + (FX bought - FX sold)**
- Net long position in currency = FI bought more currency than it has sold or have more FX assets than liabilities.
- Net short position in currency = FI has sold more foreign currency than it has purchased or have more FX liabilities than assets.

# Problem 1

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- Bank has Euro 14 million in assets and Euro 23 million in liabilities and has sold Euro 8 million in foreign currency trading.
- a) What is the net exposure for the Bank?
- b) For what type of exchange rate movement does this exposure put the bank at risk?

# FX Risk Exposure

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- Greater exposure to a foreign currency combined with greater volatility of the foreign currency implies greater DEAR.
- Dollar loss/gain in currency  $i$   
= [Net \$ exposure in foreign currency  $i$ ] ×  
Shock (Volatility) to the \$/Foreign currency  $i$   
exchange rate

# Trading Activities

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- Basically 4 trading activities:
  - Purchase and sale of currencies to complete international transactions.
  - Facilitating positions in foreign real and financial investments.
  - Accommodating hedging activities.
  - Speculation.

# Foreign Assets & Liabilities

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- Mismatches between foreign asset and liability portfolios.
- Ability to raise funds from internationally diverse sources presents opportunities as well as risks:
  - Greater competition in well-developed (lower risk) markets.

# Return and Risk of Foreign Investments

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- Returns are affected by:
  - Spread between costs and revenues
  - Changes in FX rates
    - Changes in FX rates are not under the control of the FI



EXAMPLE: FI issued \$200 mill one-year CDs at 8% and invested proceeds in one-year US dollar loan (50%) at 9% and one-year sterling loan (50%) at 15%. Spot exchange rate is 1.6\$/£

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- $\$100\text{mill}/1.6 = \text{£}62.5 \text{ mill}$
- Invest £62.5 mill in loans at 15%
- The revenue by the end of the year =  $\text{£}62.5 \text{ mill} \times 1.15\% = \text{£}71.875 \text{ mill}$
- Suppose that the spot exchange rate has fallen in value from \$1.6/£ to \$1.45/£ next year, hence
- $\text{£}71.875 \text{ mill} \times \$1.45/\text{£} = \$104.22 \text{ mill.}$
- Return on the investments is 4.22%
- The weighted return on the FI's asset portfolio =
- $0.5 \times 0.09 + 0.5 \times 0.0422 = 0.0661$  or 6.61% **that is less than the cost of funds 8%**

# Risk and Hedging

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- Hedge can be constructed on balance sheet or off balance sheet.
- **On - balance-sheet hedge** requires duration matching and currency matching.
- **Off-balance-sheet hedge** involves forwards, futures, options or swaps.
  - No balance sheet rebalancing;
  - No immediate cash flow only future contingent cash flow;
  - Lower costs and administration.
  - BUT, we have a default risk of counterparty.

# On balance sheet hedging

- We match maturities and currency foreign asset-liability book: \$100 mill UK loans are financed by UK CDs at 11%, 100 mill US loans are financed by US CDs at 8%. Spotrate is 1.6\$/£.
- £ Depreciation to \$1.45/£

£ Cost of liabilities:  $\$100\text{mill}/1.6 = \text{£}62.5 \text{ mill}$

$\text{£}62.5 \text{ mill} \times 1.11 = \text{£}69.375$

The repayment in Dollars:  $\text{£}69.375 \times \$1.45/\text{£} = \$100.59 \text{ mill}$

Cost of funds = 0.59%

Net return =  $(0.5 \times 0.09 + 0.5 \times 0.0422) - (0.5 \times 0.08 + 0.5 \times 0.0059) = 6.61\% - 4.295\% = 2.315\%$

# On balance sheet hedging

- £ appreciation to \$1.70/£, the return on British loan is equal to 22.188%

£ Cost of liabilities:  $\$100\text{mill}/1.6 = \text{£}62.5 \text{ mill}$

$$\text{£}62.5 \text{ mill} \times 1.11 = \text{£}69.375$$

The repayment in Dollars:  $\text{£}69.375 \times \$1.70/\text{£} = \$117.94 \text{ mill}$

Cost of funds = 17.94%

$$\text{Net return} = (0.5 \times 0.09 + 0.5 \times 0.22188) - (0.5 \times 0.08 + 0.5 \times 0.1794) = 15.59\% - 12.969\% = 2.625\%$$

- **By directly matching its foreign asset and liability book, FI lock in an positive return or profit spread whichever direction the exchange rates change over investment period.**

# Off balance sheet hedge with forward contracts

- $\$100\text{mill}/\$1.6/\text{£} = \text{£}62.5$  mill Invested  $\text{£}62.5$  mill in loans at 15%
- FI sells the expected principal and interest on a loan forward at the current forward rate  $\$155/\text{£}$
- The forward buyer of  $\text{£}$  promises to pay  $\text{£}62.5$  mill  $\times$  1.15% =  $\text{£}71.875$  mill  $\times$   $\$155/\text{£} = \$111.406$  mill in one year
- FI has a guaranteed return on a British loan =
- $(111.46 - 100)/100 = 11.406\%$
- The overall expected return on the FI's asset portfolio =
- $0.5 \times 0.09 + 0.5 \times 0.11406 = 0.10203$  or 10.203%

# Specifications of the FX futures

Currency	Contract size
JPY/USD	12 500 000
Euro/USD	31 500
BP/USD	62 500
SFr/USD	125 000
AUD/USD	100 000

- Six months in the March quarterly cycle (Mar, Jun, Sep, Dec)
- Physical delivery
- Last trading day: 9:16 a.m. Central Time (CT) on the second business day immediately preceding the third Wednesday of the contract month (usually Monday).

# Hedging with futures.

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- What is your risk if you have a long position in FX futures?
  - A. Foreign currency appreciation
  - B. Foreign currency depreciation

# Hedging with futures

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- Should you take long or short position in FX futures contracts if:
  - you are planning to sell Foreign currency in the future;
  - You want to hedge the portfolio of foreign stocks against the foreign exchange risk;
  - You are planning to borrow a syndicated loan from a foreign bank;
  - You are planning to buy foreign bonds in 2 months.
  - Liabilities in foreign currency exceed the assets in foreign currency.



# Hedging with futures

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- Futures market does not allow to institute a long-term one-year hedge usually due to defined maturity (4 times per year). So we need to rollover the futures positions into new futures contracts.
- EXAMPLE: Suppose that FI made a £100 mill loan at 15% and wished to hedge fully the risk of £ depreciation. The spot exchange rate is \$1.47/£ and forward exchange rate is \$1.46/£
- The size of each £ futures contract is £62500, therefore, the number of contracts needed:
- $N_f = £115 \text{ mill} / £62500 = 1840$  contracts to be sold.

# Example (continued)

- Suppose that by the end of the year the £ depreciates against the \$ from \$1.47/£ to \$1.42/£ at the spot market and from \$1.46/£ to \$1.41/£ at the forward market.
- Loss on the £ loan:
- $\text{£}115 \text{ mill} \times (\$1.47/\text{£} - \$1.42/\text{£}) = \$5.75 \text{ mill}$
- Gain on futures contracts:
- $1840 \times \text{£}62500 \times (\$1.46/\text{£} - \$1.41/\text{£}) = \$5.75 \text{ mill}$
- In this example we ignore the marking to market effect and the basis risk:
  - If spot and futures prices are not perfectly correlated, then basis risk remains.
  - Tailing the hedge
    - Interest income effects of marking to market allows hedger to reduce number of futures contracts that must be sold to hedge

# Basis Risk

- Suppose we have a basis risk:  $\Delta S = -5 \text{ c}$  and  $\Delta F = -3 \text{ c}$
- Loss on the £ loan:
- $\text{£}115 \text{ mill} \times (\$1.47/\text{£} - \$1.42/\text{£}) = \$5.75\text{mill}$
- Gain on futures contracts:
- $1840 \times \text{£}62500 \times (\$1.46/\text{£} - \$1.43/\text{£}) = \$3.45 \text{ mill}$
- $\text{Net Loss} = 5.75 - 3.45 = 2.3 \text{ mill}$
  
- In order to adjust for basis risk we apply the hedge ratio:  
$$h = \Delta S_t / \Delta f_t$$
- **$N_f = (\text{Long asset position} \times h) / (\text{size of one contract}).$**

# Example (continued)

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- $H = 0.5/0.3 = 1.66$
- $N_f = (\text{£}115\text{mill} \times 1.66) / \text{£}62500 = 3054.4$   
contracts
- Gain on futures position:
- $3054 \times \text{£}62500 \times (\text{\$}1.46/\text{£} - \text{\$}1.43/\text{£}) = \text{\$}5.73$   
mill
- Net loss = 0.02 mill

# Estimating the Hedge Ratio

- Look at recent past behavior of  $\Delta S_t$  relative to  $\Delta F_t$
- The  $h$  may be estimated using ordinary least squares regression:
  - $\Delta S_t = \alpha + \beta \Delta f_t + u_t$
  - The hedge ratio,  $h$ , will be equal to the coefficient  $\beta$ . The  $R^2$  from the regression reveals the effectiveness of the hedge.
- $R^2 = \rho^2 = [\text{Cov}(\Delta S_t, \Delta F_t)] / [\delta_{\Delta S_t} \delta_{\Delta F_t}]$

# Fixed-for-fixed currency swap:

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- Exchange of principal and interest payments in one currency for principal and interest payments in another currency.
- The principal should be specified for each of two currencies;
- The principal is usually exchanged at the beginning and at the end of the life of the swap (note, in an interest rate swap the principal is not exchanged)

# Currency Swaps

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- Fixed-Fixed

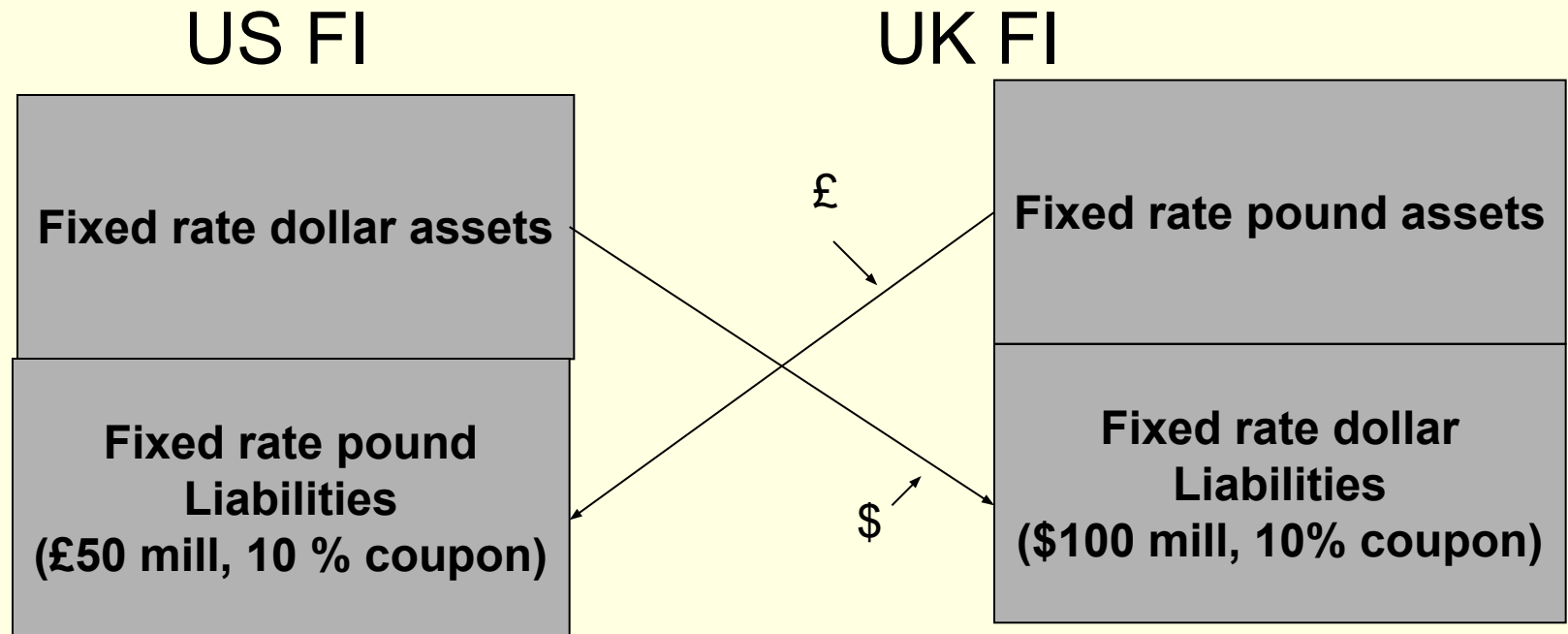
- Example: U.S. bank with fixed-rate assets denominated in dollars, partly financed with £50 million in 4-year 10 percent (fixed) notes. By comparison, U.K. bank has assets partly funded by \$100 million 4-year 10 percent notes.

- US FI has the risk of dollar depreciation

- UK FI has the risk of dollar appreciation

- Solution: Enter into currency swap.

# Example (continued)





# Cash Flows from Swap

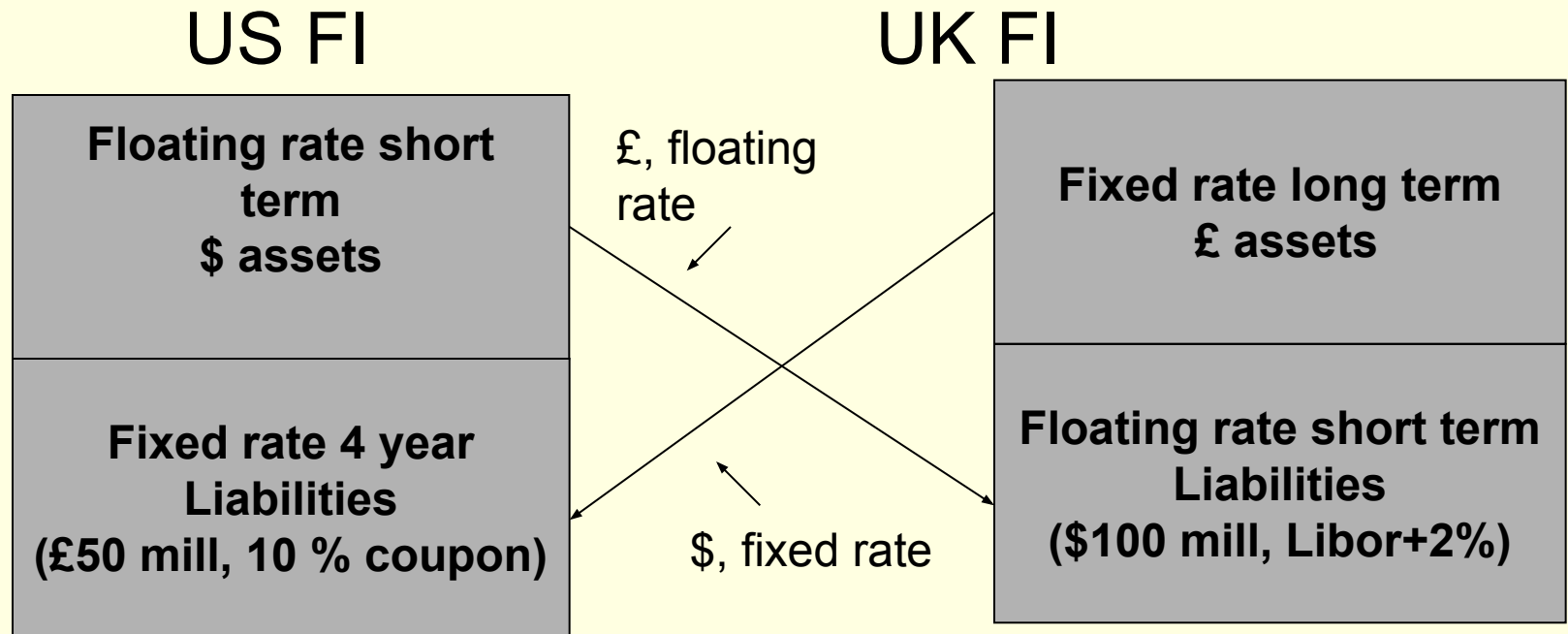
	<b>U.S. FI</b>	<b>U.K. FI</b>
Outflows (B/S)	$-10\% \times \text{£}50$	$-10\% \times \$100$
Inflows (Swap)	$10\% \times \text{£}50$	$10\% \times \$100$
Outflows (Swap)	<u><math>-10\% \times \\$100</math></u>	<u><math>-10\% \times \text{£}50</math></u>
Net	$10\% \times \$100$	$-10\% \times \text{£}50$
Rates on notes	10.5%	10.5%

# Fixed-Floating + Currency

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- Fixed-Floating currency swaps.
  - Allows hedging of interest rate and currency exposures simultaneously
- Example:
- FIs make payments at some prearrange \$/£ exchange rate (\$2/£)

# Example (continued)



# Financing costs from fixed-floating currency swap

	U.S. FI	U.K. FI
Outflows (B/S)	$-10\% \times \text{£}50$	$-(L+2\%) \times \$100$
Inflows (Swap)	$10\% \times \text{£}50$	$(L+2\%) \times \$100$
Outflows (Swap)	<del><math>-(L+2\%) \times \\$100</math></del>	<del><math>-10\% \times \text{£}50</math></del>
Net	$-(L+2\%) \times \$100$	$-10\% \times \text{£}50$
Rates available:		
\$ float rate notes	$L+2.5\%$	
£ fixed rate notes		$11\%$