

forward markets

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in the news

- “During this period [market turmoil in Oct-Nov 2008], foreign commercial banks were a source of heavy demand for U.S. dollar funding, thereby putting additional strain on global bank funding markets, including U.S. markets, and further squeezing credit availability in the United States”

Ben Bernake, 2008, Reflections on a Year of Crisis

URL: <http://www.federalreserve.gov/newsevents/speech/bernanke20090821a.htm>

learning objectives

- Understand how foreign currency forwards are quoted and used for hedging purposes
- Describe how arbitrage in the forwards markets might arise
- Illustrate how firms fund positions by using the forward markets
- Discuss developments in the global money market during the financial crisis 2007-2008

exchange rate risk and hedging

- Exchange rate movements are highly unpredictable and volatile
- Currency risk refers to adverse effects of unanticipated exchange rate changes on the cash flows or firm market value
- **Hedging: Firms manage exchange risk by taking offsetting positions to reduce the uncertainty of future cash flows**

foreign exchange forwards

- Forwards: OTC agreement to exchange currencies at certain exchange rate in the future
- You will sell (buy) foreign currency forward if you receive (pay) some foreign currency in the future. The forward rate is “locked in” at the current date → FX risk is eliminated
- The most active forward markets are for 30, 90, 180, 270, and 360 days, and nowadays up to ten years

hedging with forwards

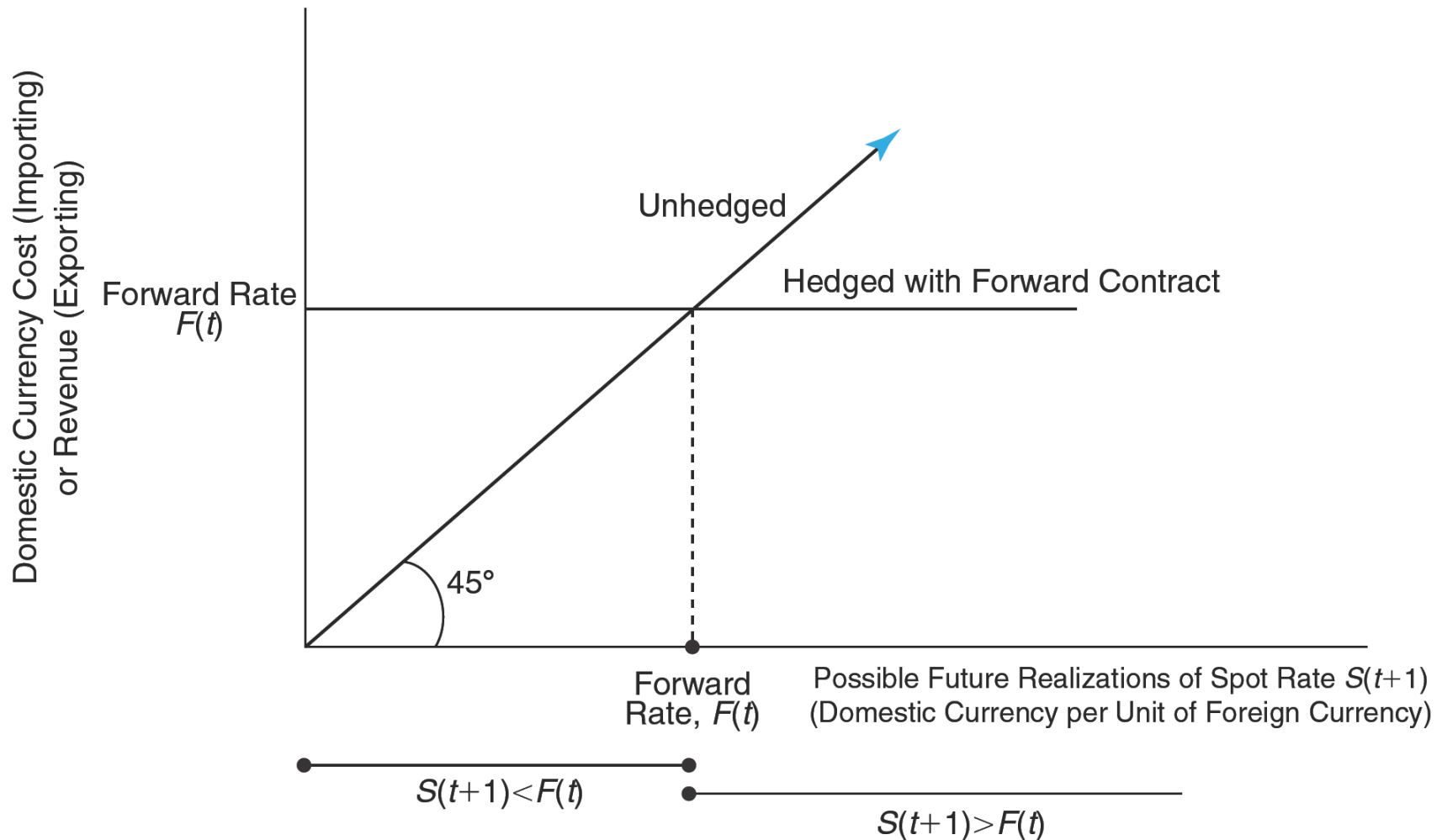
- GM needs to pay SF180 million for equipments imported from Switzerland in 3-month. The current spot rate is SF 1.48/\$. GM is afraid that SF will appreciate against \$
- **Option 1: Do nothing now and will pay the spot in 3-month**
 - If the future spot rate is SF1.48/\$, GM will pay: $SF180,000,000 / SF1.48/\$ = \$121,621,600$
 - If the future spot rate is SF1.20/\$, GM will pay: $SF180,000,000 / SF1.20/\$ = \$150,000,000$

hedging with forwards

- Option 2: GM buys SF forward from Citibank at a forward rate of SF1.455/\$
 - In 3-month, if the future spot rate is SF1.20/\$, GM will pay \$150,000,000 in the spot transaction
 - However, GM will gain because GM buys SF at **cheaper** price in the forward transaction. The profit will be SF180,000,000/SF1.455/\$ - \$150,000,000
 - Effectively, GM will pay SF180,000,000/SF1.455/\$ = \$123,711,340 or locks in the FX rate of SF1.455
- How does Citibank hedge the forward position?

unhedged vs. hedged with forwards

Panel A: General Case



forward premium/discount

- The forward rate F of the euro (€/£) can be:
 - Same as the spot rate
 - Higher than the spot rate (euro at a **discount**)
 - Lower than the spot rate (euro at a **premium**)
- The forward premium or discount of the foreign currency is expressed in **annualized percentages** as:
 - Under direct quotation
$$=(F-S)/S \times (360/N) \times 100\%$$
, N : number of days
 - Under indirect quotation
$$=(S-F)/F \times (360/N) \times 100\%$$

forward premium/discount

	Direct(\$/£)	Indirect(\$/£)
Spot	1.4681	0.6811
3mth FWD	1.4665	0.6818

- FWD discount/premium of the £
 - Direct: $\frac{1.4665-1.4681}{1.4681} \times \frac{360}{90} \times 100\% = -0.43\%$
 - Indirect: $\frac{0.6811-0.6818}{0.6818} \times \frac{360}{90} \times 100\% = -0.43\%$

covered interest rate parity

- Covered Interest Rate Parity can be summarised as:

$$(1 + i) = \frac{1}{S} (1 + i^*) \times F$$

- S : the spot rate (domestic currency/ foreign currency)
- F : the forward rate (domestic currency/foreign currency)
- i : the domestic currency interest rate for one period
- i^* : the foreign currency interest rate for one period
- For simplicity, we consider one period of one year

covered interest rate parity

$$CIRP: (1+i) = \frac{1}{S} (1+i^*) \times F$$

- Covered Interest Rate Parity (CIRP) holds due to the law of no arbitrage
- *Left hand side (LHS)*: the principal and interest of **borrowing** 1 home currency unit over the period
- *Right hand side (RHS)*: The proceeds of (1) **selling** 1 home currency unit **spot**, (2) **lend** the foreign currency in the foreign money market, and (3) **sell** the foreign currency **forward**
- If $LHS \neq RHS$, there is an arbitrage opportunity

covered interest rate parity and forward premium/discount

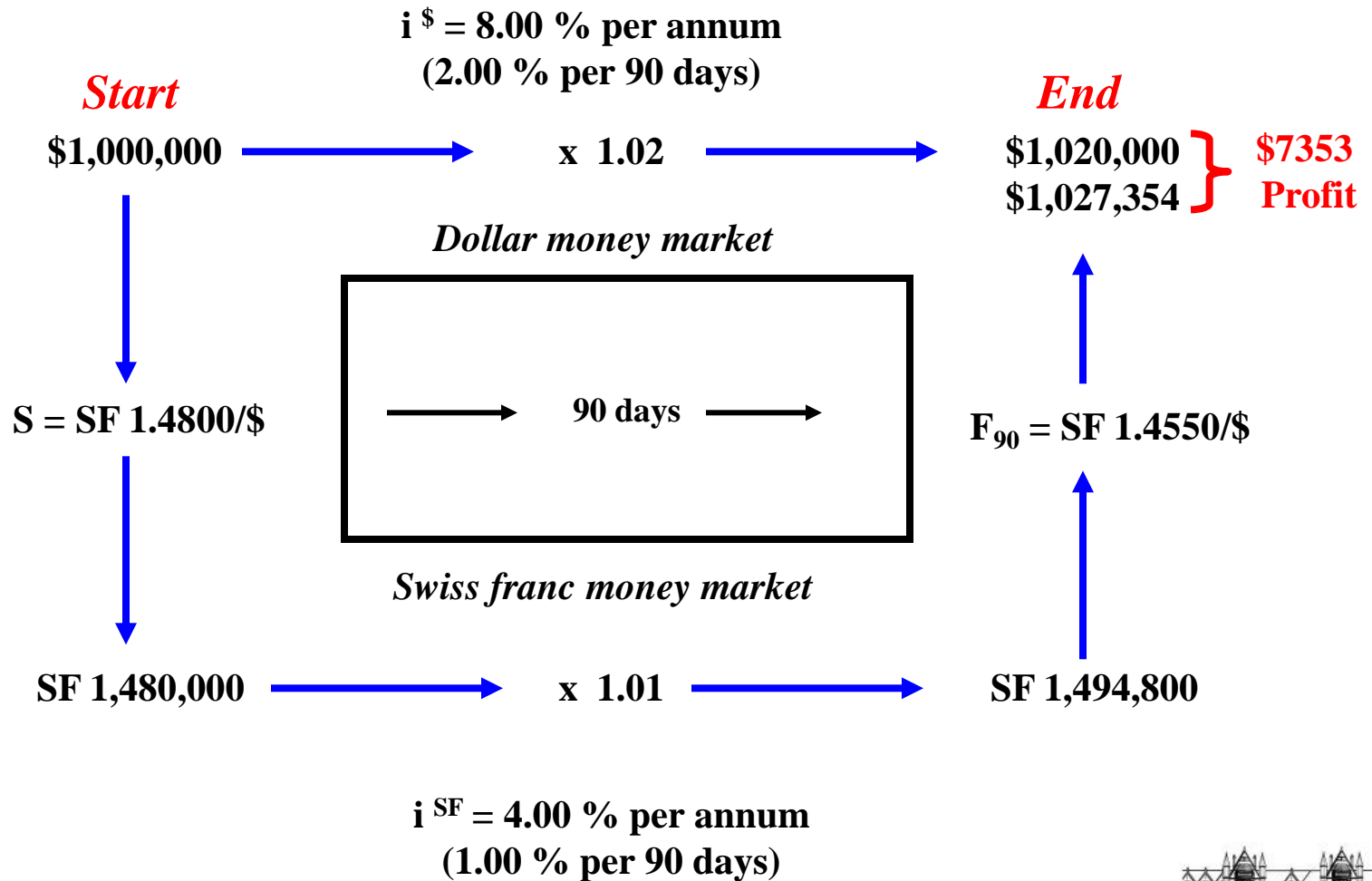
- From $\frac{(1+i)}{(1+i^*)} = \frac{F}{S}$, subtract 1 from both side we obtain
- $\frac{(1+i) - (1+i^*)}{(1+i^*)} = \frac{F-S}{S}$, or $\frac{i-i^*}{(1+i^*)} = \frac{F-S}{S}$
- If i^* is small or $1+i^* \approx 1$ then, $i-i^* = \frac{F-S}{S}$

Interest differentials = forward premium/
discount

covered interest rate arbitrage

- Example:
 - If the spot rate $S_{\text{SF}/\$} = 1.4800$
 - 3-month forward rate $F^{90}_{\text{SF}/\$} = 1.4550$
 - Annualized interest rates: $i_{\$} = 8\%$, $i_{\text{SF}} = 4\%$,
 - Interest rate differentials = $8\% - 4\% = 4\%$
 - Forward premium on SF:
 $(1.4800 - 1.4550) / 1.4550 * (360/90) * 100\% = 6.8\%$
 - $4\% < 6.8\% \rightarrow$ Arbitrage

covered interest rate arbitrage



covered interest rate arbitrage

- Speculators could do the following:
 - Convert \$1,000,000 at the spot rate to SF1,480,000
 - Invest the proceeds SF1,480,000 in a SF money market account for 3 months, earning 4% per annum (or 1% per 90 days)
 - Simultaneously sell the future proceeds SF1,494,800 3-month forward at the rate of 1.4550, locking in 1,027,354
 - Pay the \$ principal and interest rates (8% per annum or 2% per 90 days): 1,020,000
 - Earn the profit: $1,027,354 - 1,020,000 = 7353\$$ or 2.94% per annum
- Arbitrage opportunities consequently lead to
 $\downarrow S_{SF/\$}$ or $F_{SF/\$} \uparrow$

forwards and position funding

$$CIRP : (1 + i) = \frac{1}{S} (1 + i^*) \times F$$

- Financial institutions use forwards to raise foreign currencies
 - Example: BNP, a French bank, needs to borrow USD to meet its USD commitments
 - LHS: BNP can borrow USD directly in the interbank cash market for USD
 - RHS: OR, BNP can (1) borrow EUR in the EUR cash market and (2) sell EUR proceeds spot and (3) simultaneously buy the same EUR amount forwards

forwards and position funding

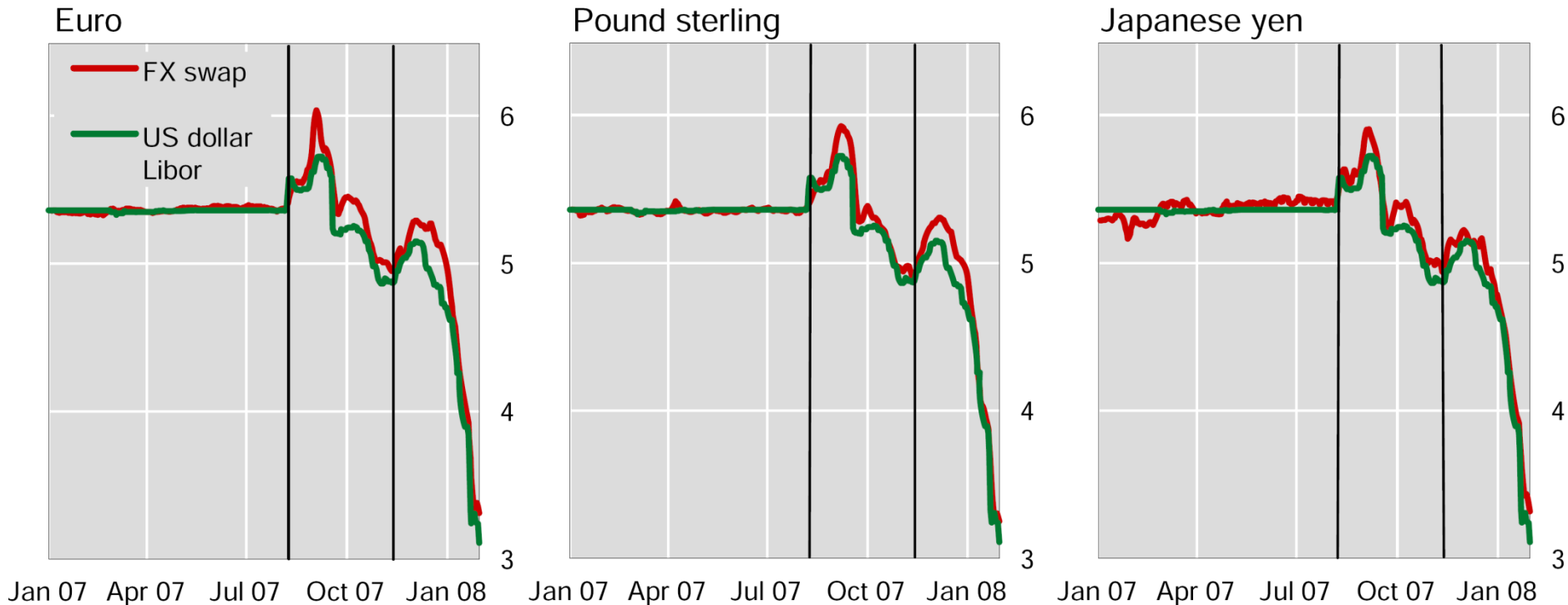
- The simultaneous spot and the reverse forward positions are often combined in one trade, which is called “**foreign exchange swap**”
- If CIRP holds, LHS should be the same as RHS
- Hence, the FX swap implied dollar rate using the EUR should be:

$$\text{\$ Implied Rate} = \frac{F}{S} (1 + i_{EUR}) - 1$$

forwards and position funding

- In fact at least prior to summer 2007, European banks constantly need to borrow dollars to fund their positions (such as in residential mortgages in the US)
- If the FX swap implied rate is lower than the dollar cash interest rate, banks are motivated to fund their dollar positions by raising cash in different currencies (such as JPY, GBP or the euro) and use foreign exchange swaps to meet their USD commitments
- As Baba, Packer and Nagano (2008) points out, during the financial crisis, the usual suppliers of dollar funds in interbank markets are not willing to lend, causing abnormal supply/demand imbalances in the global money markets

fx swap implied rate



Source: Baba, Packer and Nagano (2008)

further readings

- ESM: Chapter 6
- Bekaert and Hodrick (2009): Chapter 3
- Baba, Packer and Nagano (2008): The spill over of money market turbulence to FX swap and cross-currency swap markets, BIS Quarterly Review