UNIT-IV
SWAPS

INTEREST RATE AND CURRENCY SWAPS

Definition

A *swap* is a contract between two parties to deliver one sum of money against another sum of money at periodic intervals.

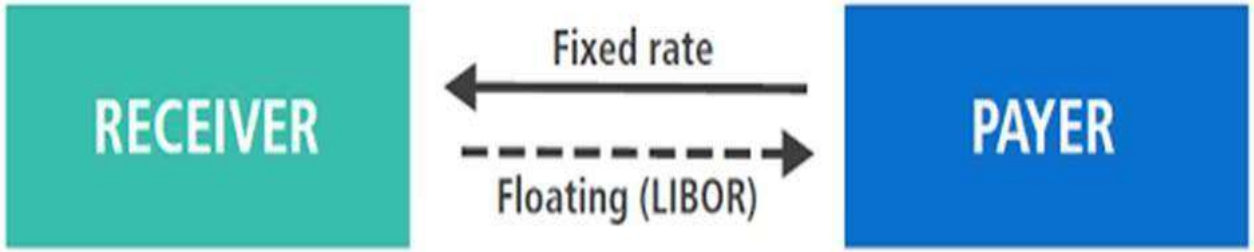
- Obviously, the sums exchanged should be different:
  - Different amounts (one is a fixed payment, the other one is a variable payment)
  - Different currencies

- The two payments are the *legs* or sides of the swap.
  - Usually, one leg is *fixed* and one leg is *floating* (a market price).

Interest Rate Swap

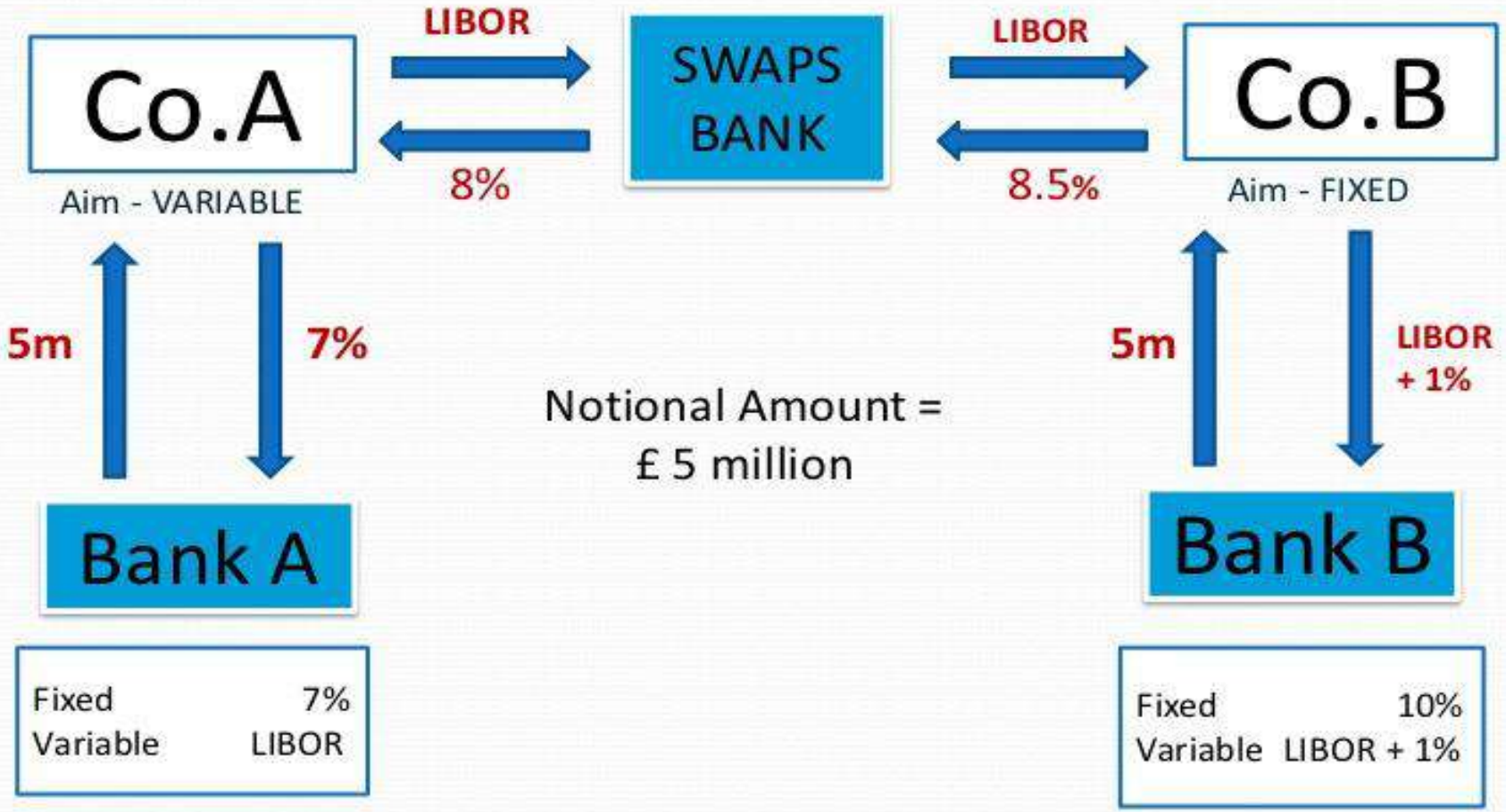
- An **interest rate swap** is a contractual agreement between two parties to exchange interest payments.
- *Interest rate swaps* provide a way for businesses to hedge their exposure to changes in interest rates.
- If a company believes long-term interest rates are likely to rise, it can hedge its exposure to interest rate changes by exchanging its floating rate payments for fixed rate payments.

Interest rate



swap valuation

Interest Rate Swap Example



Interest rate swaps -- Meaning

- An interest rate swap is a financial agreement between the two parties who wish to change the interest payment or receipts in the same currency on assets or liabilities to a different basis.
- No exchange of principal amount in this swap.
- This is also known in the market as plain vanilla swap.
- Principal amount applies only for the purpose of calculating the interest to be exchanged under interest rate swap.
- Maturities range from a year to over 15 years.

❖ **Feature of interest rate swaps:**

- **Notional principal:**

➢ Interest amount whether fixed or floating is calculated on a specified amount borrowed or lent.

➢ Parties do not exchange this amount at any time., it remains constant throughout the life of the swap.

- **Fixed rate:**

➢ This is the rate, which is used to calculate the size of the fixed payment.

➢ Banks or financial institutions who make market in interest rate swap quote the fixed rate, they are willing to pay if they are fixed rate payers in a swap (bid swap rates) , they are willing to receive if they are floating rate player in a swap

(ask swap rate).

Fixed payment =(P) x (Rfp) x (Ffp)

Where P is the notional payment, Rfp is the fixed price, Ffp is the fixed day count fraction.

- **Floating rate:**

➢ Floating rate as one of the market indexes like LIBOR (London Inter Bank Offer Rate).

➢ Treasury Bill rate, primary rate, etc. on which basis the floating interest rate is determined in the swap agreement.

- Floating payment = (P) x (Rfe) x (Ffe)
- Where P is notional payment, Rfe is the floating rate set on the reset date, Ffx is the floating rate day count fraction.

❖ **Trade date, effective date, reset date, payment date:**

- **Trade date:**

- Fixed rate payment are normally paid semi-annually or annually. For example, it may be March 1, September 1 etc.
- Trade date may be defined as such date on which the swap deal is concluded.

- **Effective date:**

- Effective date is that date from which the first fixed and floating payment start to accrue.
- For example, a 5- year swap is traded on August 30, 2002 the effective date may be September 1, 2002, and ten payment dates from March 1, 2003 to September 1, 2007.

How it works (Example):

- The most common type of interest rate swap is one in which Party A agrees to make payments to Party B based on a fixed interest rate, and Party B agrees to make payments to Party A based on a floating interest rate.
- The floating rate is tied to a reference rate (in almost all cases, the London Interbank Offered Rate, or LIBOR).

❖ **Example for calculation of fixed and floating interest rate:**

Let us assume Party X on a semi-annual basis, pays 7 per cent rate of interest on the notional amount and receives from the Party Y LIBOR + 30 basis points . The current six- month LIBOR rate is 6.30 per cent per annum. The notional principal is Rs. 35 crore.

Amount to be paid as per fixed rate:

Notional principal x (Days in period/365) (Interest rate/100)

350000000 x (182/365) x (7/100) = Rs. 1221644

Amount to be paid as per floating rate:

Notional principal x (Days in period/365) (Interest rate + base/100)

350000000 x (182/365) x (6.30 + .30/100) = Rs. 1167833

In a swap, the payments are netted. In this case, Party X pays Party Y the net difference.

Rs. 1221644 - Rs. 1167833 = Rs.53810

❖ **Types of interest rate swaps:**

- **Plain vanila swap:**

➢ It is also known as fixed-for-floating swap.

➢ One party with a floating interest rate liability is exchanged with fixed rate liability.

➢ Period ranges from 2 years to over 15 years for a pre-determined notional principal amount.

- **Zero coupon to floating:**

➢ Holders of zero-coupon bonds get the full amount of loan and interest accrued(**accumulate)** at the maturity of the bound.

➢ The fixed rate player makes a bullet payment at the end and floating rate player makes the periodic payment through out the swap period.`

- **Alternative floating rate:**

➢ Floating reference can be switched to other alternatives as per the requirement of the counter party.

➢ These alternatives include three-month LIBOR, one-month commercial paper, T-Bill rate etc.

➢ Alternative floating interest rates are charged in order to meet the exposure of other party.

- **Floating-to-floating:**

➢ One party pays one floating rate, say, LIBOR while the other counter party pays another, say, prime for a specified time period.

➢ These swap deals are mainly used by the non-US banks to manage their dollar exposure.

- **Forward swap:**

➢ This swap involves an exchange of interest rate payment that does not begin until a specified future point of time.

- **Swaptions:**

- Swaptions are combination of the features of two derivative instruments i.e. option and swap.
- Option interest rate swaps are referred as swaptions.
- Buyer of the swaption has the right to enter into an interest rate swap agreement by some specified date in the future.
- Swaption will specify whether the buyer of the swaption will be a fixed rate receiver or a fixed rate payer.
- Buyer exercises the option then the writer of the option will become the counter party.

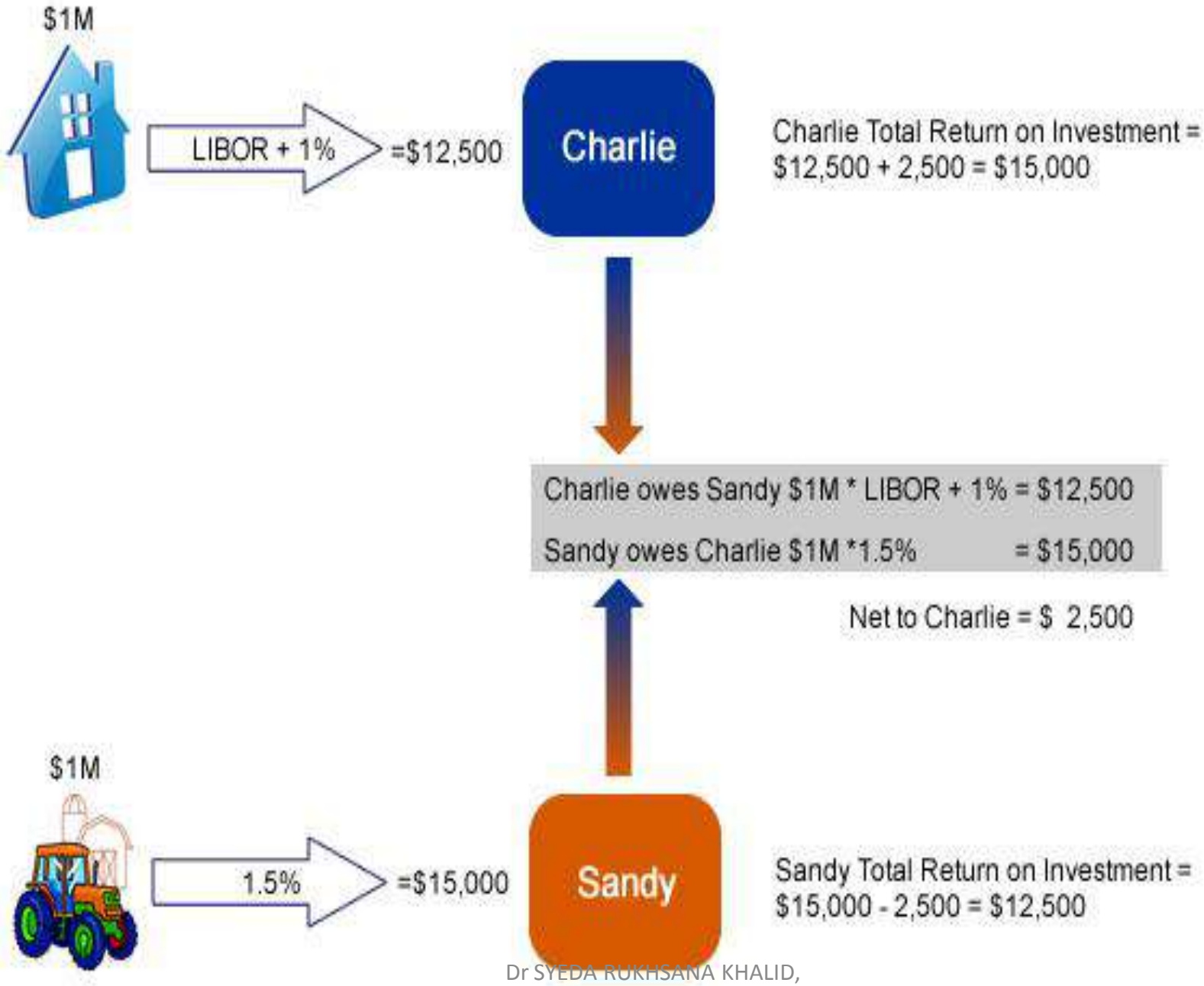
- **Equity swap:**

- Equity swap involves the exchange of interest payment linked to the change in the stock index.
- Example , an equity swap agreement may allow a company to swap a fixed interest rate of 6 per cent in exchange for the rate of appreciation on a particular index say BSE or NSE index.

For example,

- Assume that Charlie owns a $1,000,000 investment that pays him LIBOR + 1% every month.
- As LIBOR goes up and down, the payment Charlie receives changes.
- Now assume that Sandy owns a $1,000,000 investment that pays her 1.5% every month. The payment she receives never changes.
- Charlie decides that that he would rather lock in a constant payment and Sandy decides that she'd rather take a chance on receiving higher payments.
- So Charlie and Sandy agree to enter into an interest rate swap contract.
- Under the terms of their contract, Charlie agrees to pay Sandy LIBOR + 1% per month on a $1,000,000 principal amount (called the ***"notional principal" or "notional amount***").
- Sandy agrees to pay Charlie 1.5% per month on the $1,000,000 notional amount.

- **Scenario A: LIBOR = 0.25%**
- Charlie receives a monthly payment of $12,500 from his investment ($1,000,000 x (0.25% + 1%)).
- Sandy receives a monthly payment of $15,000 from her investment ($1,000,000 x 1.5%).
- Now, under the terms of the swap agreement, Charlie owes Sandy **$12,500** ($1,000,000 x LIBOR+1%) ,
- and she owes him **$15,000** ($1,000,000 x 1.5%).
- The two transactions partially offset each other and Sandy owes Charlie the difference**: $2,500.**


$1M
LIBOR + 1%
=$12,500
Charlie
Charlie Total Return on Investment =
$12,500 + 2,500 = $15,000
Charlie owes Sandy $1M * LIBOR + 1% = $12,500
Sandy owes Charlie $1M *1.5% = $15,000
Net to Charlie = $ 2,500
$1M
1.5%
=$15,000
Sandy
Sandy Total Return on Investment =
$15,000 - 2,500 = $12,500

Scenario B: LIBOR = 1.0%

- Now, with LIBOR at 1%, Charlie receives a monthly payment of **$20,000** from his investment ($1,00,000 x (1% + 1%)).
- Sandy still receives a monthly payment of **$15,000** from her investment ($1,000,000 x 1.5%).
- With LIBOR at 1%, Charlie is obligated under the terms of the swap to pay Sandy **$20,000** ($1,000,000 x LIBOR+1%), and Sandy still has to pay Charlie **$15,000**.
- The two transactions partially offset each other and now Charlie owes Sandy the difference between swap interest payments: **$5,000**.

$1M

LIBOR + 1%

=$20,000

Charlie

Charlie Total Return on Investment =
$20,000 - 5,000 = $15,000

Charlie owes Sandy $1M * LIBOR + 1% = $20,000

Sandy owes Charlie $1M *1.5% = $15,000

Net to Sandy = $ 5,000

$1M

1.5%

=$15,000

Sandy

Sandy Total Return on Investment =
$15,000 + 5,000 = $20,000

- The interest rate swap has allowed Charlie to guarantee himself a $15,000 payout;
- if LIBOR is low, Sandy will owe him under the swap, but if LIBOR is higher, he will owe Sandy money.
- Either way, he has locked in a 1.5% monthly return on his investment.
- Sandy has exposed herself to variation in her monthly returns. Under Scenario A, she made 1.25% after paying Charlie $2,500, but under Scenario B she made 2% after Charlie paid her an additional $5,000.
- Charlie was able to ***transfer the risk of interest rate fluctuations to*** Sandy, who agreed to assume that risk for the potential for higher returns.
- One more thing to note is that in an interest rate swap, the parties never exchange the principal amounts.
- On the payment date, it is only the difference between the fixed and variable interest amounts that is paid; there is no exchange of the full interest amounts

Applications of Interest Rate Swaps

Swaps can be used to

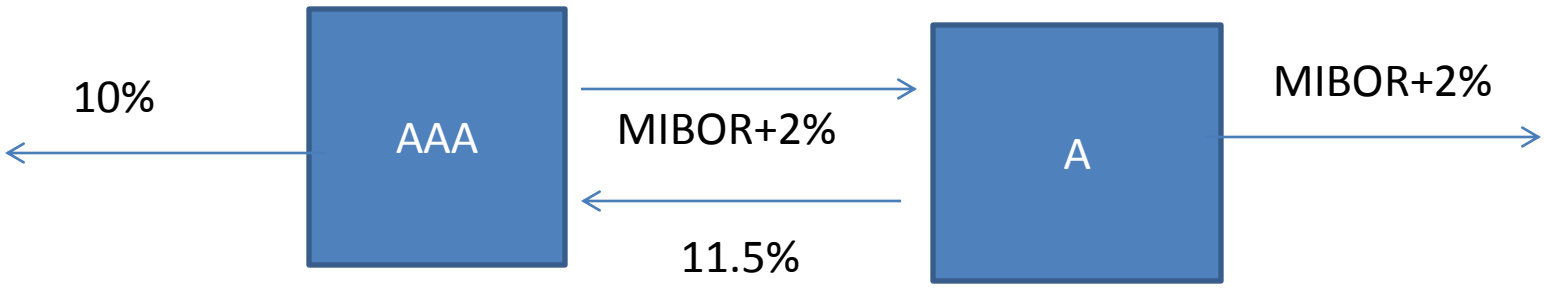
1. Transform a floating rate liability to a fixed rate liability and vice versa
2. Transform a floating rate asset to a fixed rate asset and vice versa
3. Hedge against fluctuating Interest rates and most importantly
4. ***Reduce the cost of funds***

EXAMPLE

- A highly rated firm AAA, can raise funds in the fixed rate market at 10% and in the floating market at MIBOR+100 bps.
- Another firm, comparatively rated lower, at 'A', can mobilise capital at 12% and MIBOR+200 bps in the fixed rate and floating rate markets, respectively.
- The firm rated AAA is interested in borrowing at a floating rate (at MIBOR + 100bps) and firm rated A wants to borrow in the fixed rate market (at 12%).

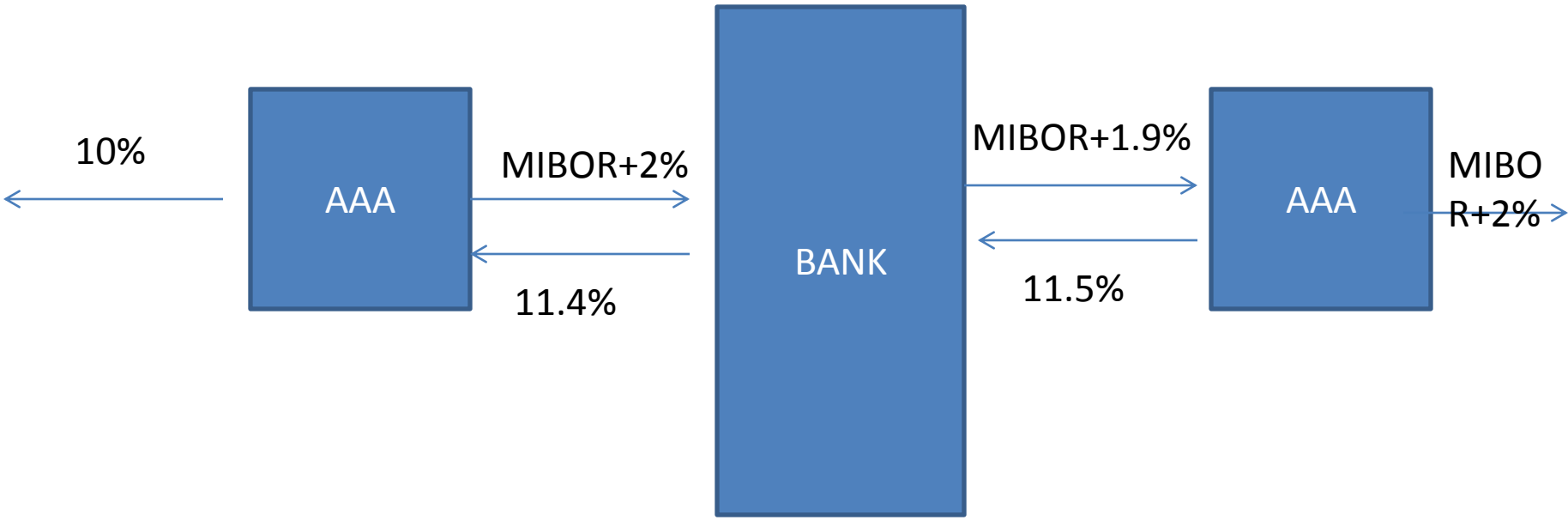
	AAA	A
Fixed Rate	10%	12%
Floating Rate	MIBOR+100 bps	MIBOR+200bps

	AAA	A	Advantage
Fixed Rate	10%	12%	**200 bps**
Floating Rate	MIBOR+100 bps	MIBOR+200bps	**100 bps**


10%
AAA
MIBOR+2%
11.5%
A
MIBOR+2%

	AAA	A
1. Payment to Investors	10%	MIBOR + 2%
2. Payment to counter party	MIBOR + 2%	11.5%
3. Receipt from Counterparty	11.5%	MIBOR + 2%
Cost of Borrowing (1 + 2 – 3)	**MIBOR + 0.5%**	**11.5%**
IMPACT	Gain 0.5%	Gain 0.5%

With Intermediary - ‘Bank’


10%
AAA
MIBOR+2%
11.4%
BANK
MIBOR+1.9%
11.5%
AAA
MIBO
R+2%

	AAA	A
Payment to Investors	10%	MIBOR + 2%
Payment to Bank	MIBOR + 2%	11.5%
Receipt from Bank	11.4%	MIBOR + 1.9%
Cost of Borrowing (1 + 2 - 3)	MIBOR + 0.6%	11.6%
Cost with Direct Access to Market	MIBOR + 1%	12%
	40 bps	40 bps

Pricing of Swap

- Price of Swap $= \frac{1}{q} \times \frac{1-PVIF(n)}{\sum_1^n \text{PVIF(i)}}$
  - Where,
  - q = Adjustment Factor
  - PVIF(n) = Present Value factor of nth term
  - $\sum_1^n$ PVIF(i) = Sum of Present Value factor of all ith term, where i tends to 1 to n.

Value of Swap

- Value of Swap is the net gain or loss to the parties involved in swap contract.
- It is the difference between present value of two streams of cash flow.
- Value of Swap is obtained by calculating the difference between Value of Floating Rate Bond and Value of Fixed Rate Bond.

Value of Plain Vanilla Swap

Plain Vanilla Swap

- If a party is paying fixed rate and receiving floating rate, then
- Value of Swap (Vs) = Value of Floating Rate Bond (V(FLRB)) - Value of Fixed Rate Bond (V(FXRB))
- If Vs>0, Party receiving fixed rate is in loss
- If Vs<0, Party receiving floating rate is in loss.

Value of Plain Vanilla Swap

Value of Floating Rate Swap

$$V(FLRB) = (Principal + Interest) \times PVIF(1)$$

$$V(FLRB) = (NP + NP \times R(FL) \times q) \times PVIF(1)$$

Here,

NP = Notional Principal

R(FL) = Floating Interest Rate

$NP \times R(FL) \times q$ = Interest (I)

PVIF(1) = Present Value factor of 1st term

Value of Plain Vanilla Swap

Value of Fixed Rate Swap

$V(FXRB) =$ Sum of Present Value of Interest + Present Value of Face Value or NP

$$V(FXRB) = NP \times R(FX) \times q \times \sum_1^n PVIF(i) + NP \times PVIF(n)$$

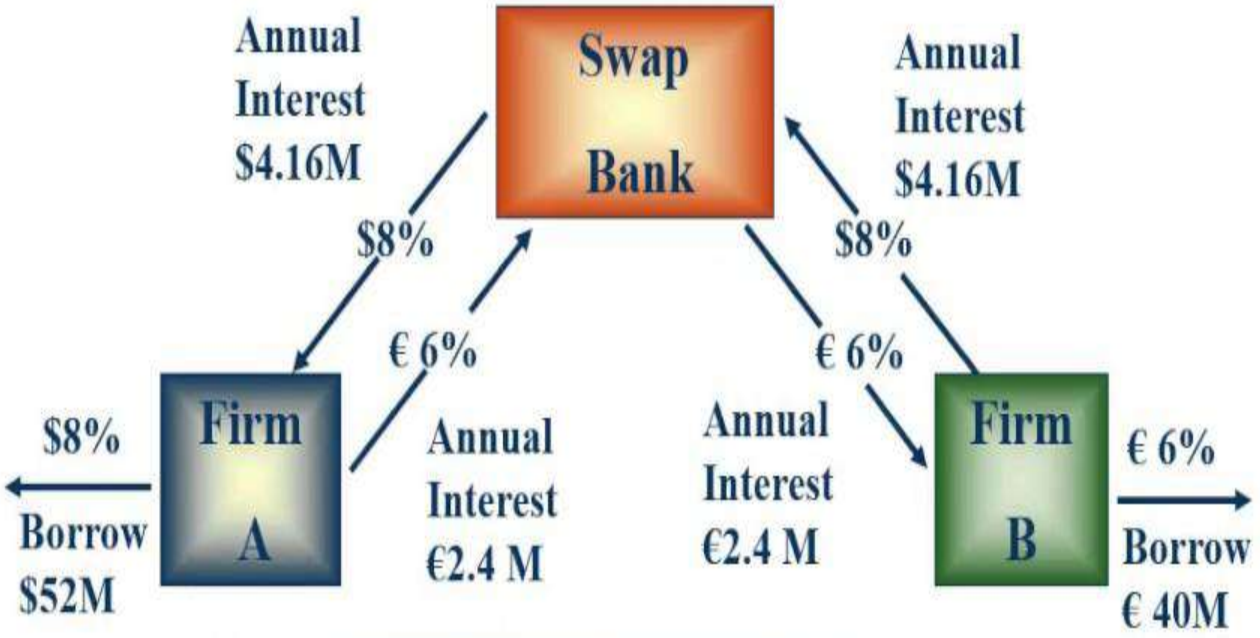
Here,

R(FX) = Fixed Rate of Bond

Meaning of Currency Swap:

- A currency swap is a **"contract to exchange at an agreed future date principal amounts in two different currencies at a conversion rate agreed at the outset".**

An Example of a Currency Swap



	$	€
Company A	8.0%	7.0%
Company B	9.0%	6.0%

Currency Swap -- Meaning

- In currency swap, the two payment streams being exchanged are denominated in two different currencies.
- Example , a firm which has borrowed Japanese yen at a fixed interest rate 'can swap' away the exchange rate risk by setting up a contract whereby it receives yen at a fixed rate in return for dollars at either a fixed or a floating interest rate.
- In currency swap three basic step are involved
- 1.**Initial exchange of principal amount** – at an agreed rate of exchange. This rate is based on the spot exchange rate.
- 2.**Ongoing exchange of interest** – after establishing the principal amount, the counter parties exchange interest payment on agreed date based on the outstanding principal amount at the fixed interest rates agreed at the outset of the transaction.
- **3.Re-exchange of principal to principal** – agreement on this enables the counter parties to re-exchange the principal sums at the maturity date.

Types of currency swaps

❖ **Fixed-to-fixed currency swap:**

- Currencies are exchanged at fixed rate.
- One firm raises a fixed rate liability in currency X, say US dollar while the other firm raises fixed rate funding in currency Y say pound.
- Principal amount are equivalent at the current market rate of exchange.
- In swap deal, first party will get pound where the second party gets dollars.
- The first party will make periodic get (pound) payment to the second, in turn gets dollar computed at interest at a fixed rate on the respective principal amount of both currencies.

❖ **Floating-to-floating:**

- The counter parties will have payments at floating rate in different currencies.

❖ **Fixed-to-floating currency swap:**

- It is a combination of a fixed-to-fixed currency swap and floating swap.
- One party makes the payment at a fixed rate in currency, say, X while the other party makes the payment at a floating rate in currency, say Y.
- Contract without the exchange and re-exchange of principals do exist.
- A financial intermediary (a swap bank) structures the swaps deal and routes the payment from one party to other party.

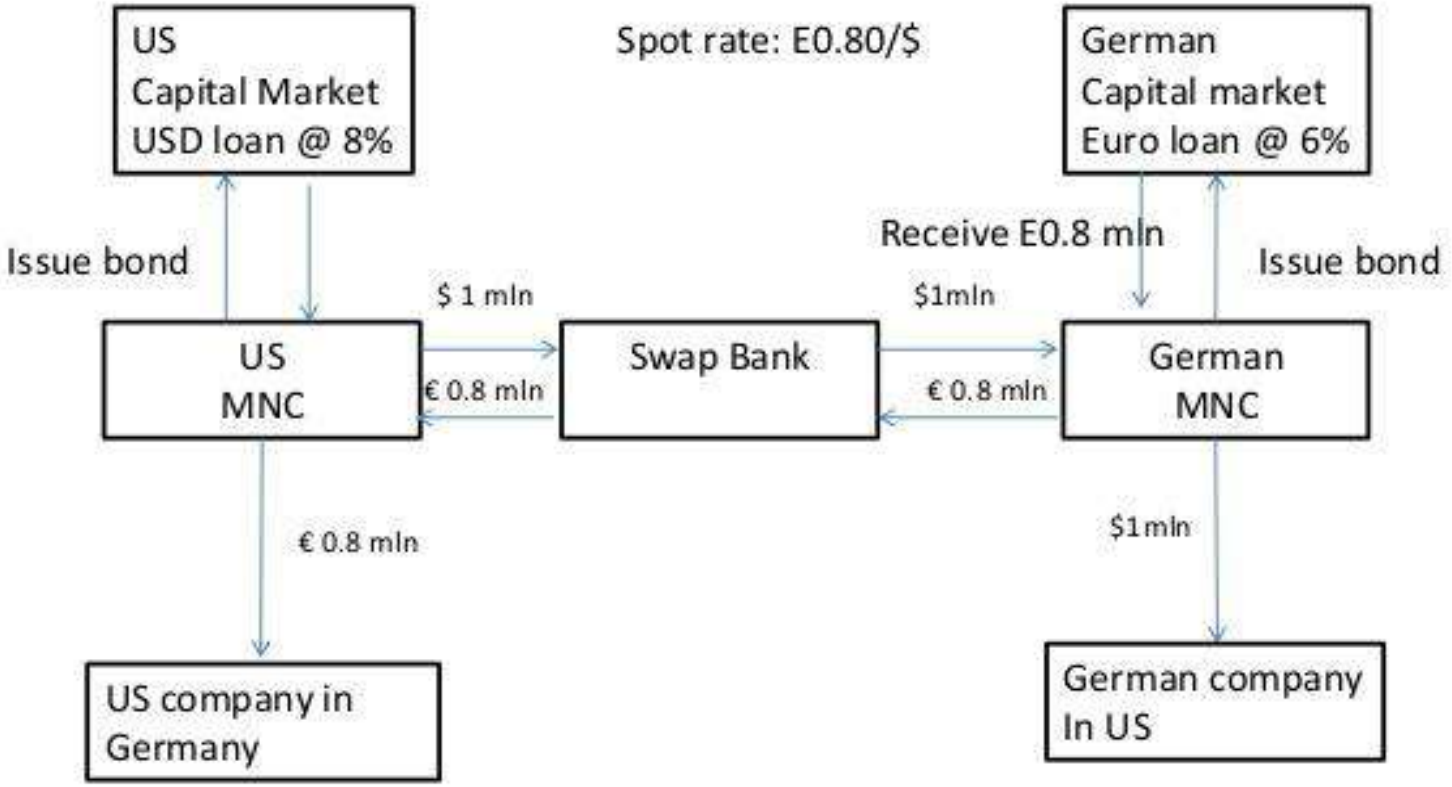
Currency Swap

	German MNC	US MNC	Differential
Dollar loan	9% on $	8% $	1%
Euro loan	6% on Euro	7% Euro	1%
			2%

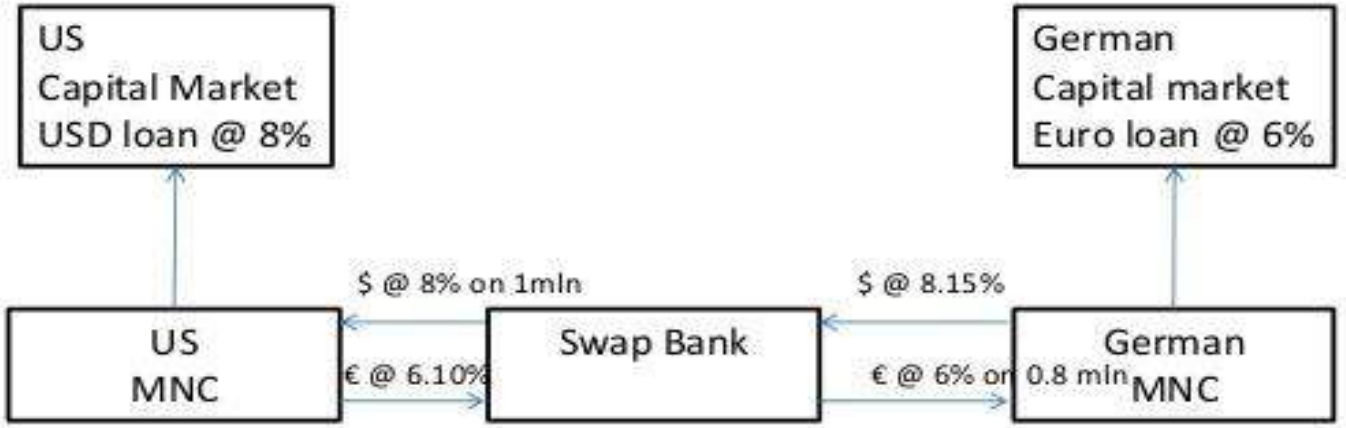
In interest rate swap, we took the difference of difference; here we are taking addition of difference.

- The process of a currency swap is the following:
  - At beginning, exchange principals
  - At the end of each period, exchange interest for the borrowed currency
  - At the end of the swap, return principals

Currency Swap (principals exchanged)



Currency Swap (interest payments)



$$PV_{fixed}(t) = RN\sum_{i=1}^{n} \tau_i D_i \qquad (1)$$

where

t – valuation date

R – fixed rate

N – notational principal amount

i – i^{th} cash flow (swaplet) from 1 to n

$\tau_i = \tau(T_{i-1}, T_i)$ – accrual period (T_{i-1}, T_i) of the i^{th} cash flow.

$D_i = D(t, T_i)$ – discount factor

$$PV_{floating}(t) = N\sum_{i=1}^{m}(F_i + s)\tau_i D_i \qquad (2)$$

where

t – valuation date

N – notational principal amount

i – i^{th} cash flow (swaplet) from 1 to n

$\tau_i = \tau(T_{i-1}, T_i)$ – accrual period (T_{i-1}, T_i) of the i^{th} cash flow.

$D_i = D(t, T_i)$ – discount factor

$F_i = F(t; T_{i-1}, T_i) = \frac{1}{\tau_i}\left(\frac{D_{i-1}}{D_i} - 1\right)$ - simply compounded forward rate

s - floating spread

Swap Rate and Swap Spread

A swap rate is the fixed rate that makes a given swap worth zero at inception.It can be easily derived from (1) and (2) as follows.

Swap spread is defined as the difference between a swap rate and the rate of an on-the-run treasury with the same maturity as the swap. The swap spread is the additional amount an investor would earn on a swap as compared to a risk-free fixed-rate investment.

Final practical notes

•Interest rate swaps are the most popular OTC derivatives. Most of them are either collateralized or cleared in the market. Therefore, pricing model should use OIS discounting to account for collateralization.

•Some dealers take bid-offer spreads into account. In this case, one should use bid curve constructed from bid quotes for forwarding and offer curve built from offer quotes for discounting.

$$R = \frac{\sum_{i-1}^{m} (F_i + s)\tau_i D_i}{\sum_{i-1}^{m} \tau_i D_i} \qquad (3)$$

Illustration 1:

- A U.S. based company intends to give loan of 5 million dollars to its counter-part in Germany for 8 years. On the other hand and at the same time, a German Company wishes to lend money to its U.S. based sister concern an amount of 5 million dollars for a period of 8 years.
- **Here, in both the cases, the intermediary Bank is same which might bring the two companies together in a parallel loan arrangement as follows:**
- (i) U.S. based Company can extend loan of 5 million dollars for a period of 8 years to the German Company's sister concern based in U.S.
- (ii) Simultaneously, the German company can lend 5 million dollars for a period of 8 years to U.S. based company's counterpart in Germany in Euro.
- The parallel loan was the antecedent to currency swap

- A currency swap is a **“contract to exchange at an agreed future date principal amounts in two different currencies at a conversion rate agreed at the outset”.**
- During the term of the contract the parties exchange interest, on an agreed basis, calculated on the principal amounts.
- A currency swap is a legal agreement between two parties to exchange the principal and interest rate obligations, or receipts, in different currencies.
- The transaction involves two counter-parties who exchange specific amounts of two currencies at the outset, and repay them over time according to a predetermined rule that reflects both the interest payment and the amortisation of the principal amount.
- A currency swap is an agreement to exchange fixed or floating rate payments in one currency for fixed or floating payments in a second currency plus an exchange of the principal currency amounts.
- Currency swap allows a customer to re-denominate a loan from one currency to another.

- The re-denomination from one currency to another currency is done to lower the borrowing cost for debt and to hedge exchange risk.
- The concept behind is to match the difference between the spot and forward rate of any currency over a specified period of time.
- Usually, banks with a global presence act as intermediaries in swap transactions, helping to being together the two parties. Sometimes, banks themselves may become counter-parties to the swap deal, and try to offset the risk they take by entering into an offsetting swap deal.
- Alternatively, banks can hedge themselves by taking positions in the futures markets.

A currency swap can consist of three stages:

1. A spot exchange of principal – this forms part of the swap agreement as a similar effect can be obtained by using the spot foreign exchange market.
2. Continuing exchange of interest payments during the terms of the swap – this represents a series of forward foreign exchange contracts during the term of the swap contract. The contract is typically fixed at the same exchange rate as the spot rate used at the outset of the swap.
3. Re-exchange of principal on maturity.

In a currency swap the principal sum is usually exchanged in one of the following manner:

(i) At the start

(ii) At a combination of start and end

(iii) At the end

(iv) Neither

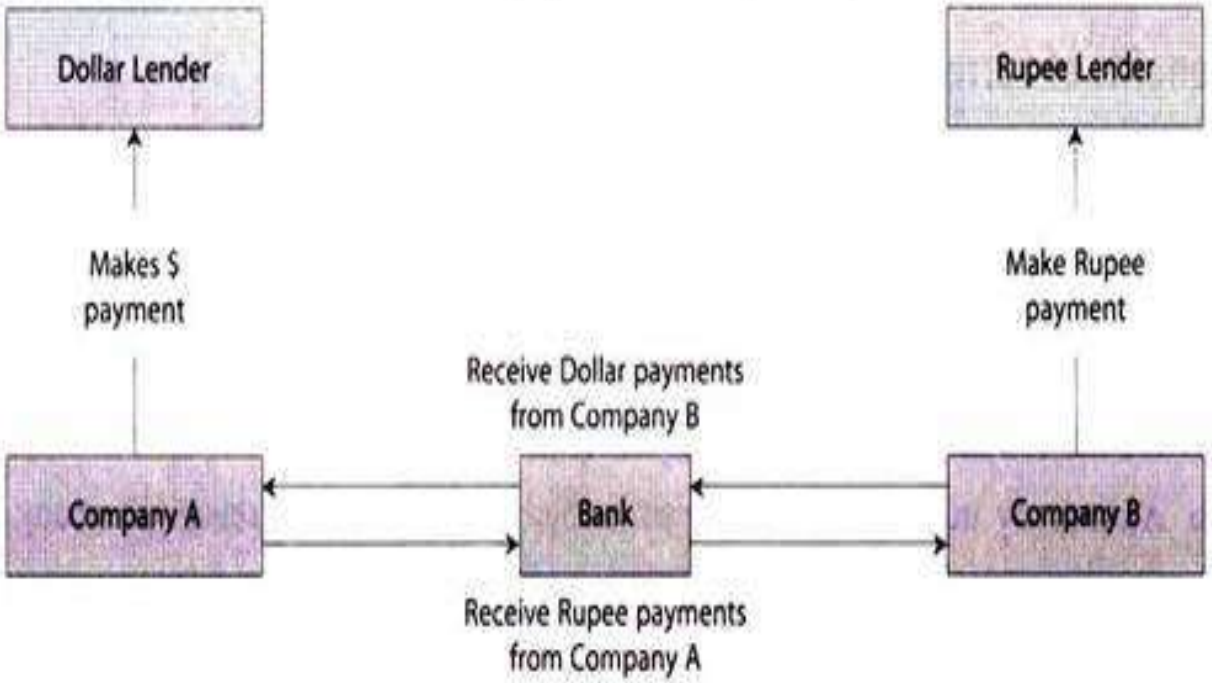
Pricing and Valuing Currency Swaps

- Four types of currency swaps exist:
  - Pay one currency at a fixed rate, receive another currency fixed rate.
  - Pay one currency at a fixed rate, receive another currency at a floating rate.
  - Pay one currency at a floating rate, receive another currency at a fixed rate.
  - Pay one currency at a floating rate, receive another currency at a floating rate.
- A currency swap will have some (not all) similarities to an interest rate swap:
  - Value is zero at initiation.
  - For currency swap types 1-3, a fixed rate must be priced that so the present values to each party are equal.
  - Regarding type 4, since both rates are floating, a fixed rate does not need to be found.
- Currency Swap Differences to Interest Rate Swaps
  - For currency swaps, an interest rate must be priced for each currency.
  - Each side of the currency swap has its own notional principal in its own currency. Therefore, if one side of the swap has a notional set to 1, then the notional for the other party will be 1/exchange rate.

- For currency swap type 1 (fixed-fixed), the rate on the domestic side is the fixed rate on a plain vanilla interest rate swap in the home country. The rate on the foreign side is the fixed rate on a plain vanilla interest rate swap in the foreign country.
- For swap types 2 and 3, (fixed-floating, floating-fixed), the fixed rate sides are determined by the fixed rate on a local swap and the floating rate will be based on the local short term rates.
- For swap type 4 (floating-floating), the floating rates are based on local market floating rates.
- Given the incremental complexity of pricing currency swaps over pricing interest rate swaps, candidates are encouraged to obtain proficiency in successfully pricing plain vanilla interest rate swaps before pricing currency swaps.
- Valuing Currency Swaps
  - The same approach to valuing interest rate swaps applies to valuing currency swaps, with the additional complexity of moving exchange rates. This will make calculating the present values to each swap party a little more complicated.

FIGURE 15.14 CURRENCY SWAP

Company A borrows in Dollars and Company B borrows in Rupees. They enter in a Currency Swap.



Motivation underlying swaps

- Swap are important techniques or technology for transforming the characteristics of financial claim.
- There is a different risk perception between markets. Example, bond market and bank credit market evaluate the companies differently because their credit assessment is subjective.
- A company can raise the fund in particular market at lower cost where it receives better evaluation, which it can swap into the desired type of instrument.
- I t relates with regulation of issuers and investors concerning the respective governments.
- Government regulation that seeks to limit the amount of debt issue by the foreign companies to protect domestic investors from increased risks and preventing to borrow from local markets.

- Government regulation makes certain markets more attractive to particular companies (**usually domestic**) than others.
- There is subsidized financing available in certain type of business , for example export financing.
- A currency swap may allow a company to take advantage of such situation.
- The availability of funds in different markets changes due to temporary supply/ demand imbalances.
- Lowering reserve requirement for bank will result in increase of supply of funds in the bank credit and rates fall down.
- The borrower will desire to go in such market where the supply is in excess.
- It is related to balance-sheet position of the counter parties.
- Swapping provides better opportunities to determine the type of assets and liabilities it wants to carry.