Derivatives

Interest Rate Swaps
Currency Swaps
Forward Rate Agreements

cesariomateus@gmail.com

www.cesariomateus.com

Swaps

"Plain vanilla" Interest rate swap (most common type of swap).

Company agrees to pay cash flows equal to interest at a predetermined fixed rate on a notional principal for a number of years.

In return, it receives at a floating rate on the same notional principal for the same period of time.

LIBOR (London Interbank Offered Rate): Floating rate used in most interest rate swaps agreements.
Rate of interest at which a bank is prepared to deposit money with other banks in the Eurocurrency market.
Typically, 1-month, 3-month, 6-month and 12-month (LIBOR is quoted in all major currencies)

Example

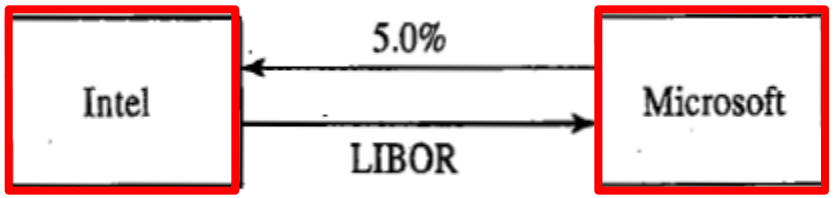
3-year swap initiated in March, 5th, 2007, between Microsoft and Intel.

Microsoft agrees to pay Intel an interest rate of 5% per annum on a principal of $100 million.

Intel agrees to pay Microsoft the 6-month LIBOR rate on the same principal.

Microsoft: fixed-rate payer
Intel: Floating rate payer

We assume that payments are to be exchanged every 6-months and that the 5% interest rate is quoted with semi-annual compounding.



Cash Flows (millions of dollars) to Microsoft in a $100 million 3-year interest rate swap when a fixed rate of 5% is paid and LIBOR received

Date	Six-month Libor (%)	Floating cash flow received	Fixed cash flow paid	Net cash flow
Mar. 5, 2007	4.20			
Sept. 5, 2007	4.80	+2.10	-2.50	-0.40
Mar. 5, 2008	5.30	+2.40	-2.50	-0.10
Sept. 5, 2008	5.50	+2.65	-2.50	+0.15
Mar. 5, 2009	5.60	+2.75	-2.50	+0.25
Sept. 5, 2009	5.90	+2.80	-2.50	+0.30
Mar. 5, 2010		+2.95	-2.50	+0.45

Using the Swap to Transform a Liability

Swap can be used to transform a floating-rate loan into a fixed-rate loan.

Suppose:
Microsoft has arranged to borrow $100 million at LIBOR plus 10 basis points.
Three sets of cash flows:

1. It pays LIBOR plus 0.1% to its outside lenders
2. It receives LIBOR under the terms of the swap
3. It pays 5% under the terms of the swap

Microsoft swap have the effect of transforming borrowing at a floating rate of LIBOR plus 10 basis points into borrowings at a fixed rate of 5.1%

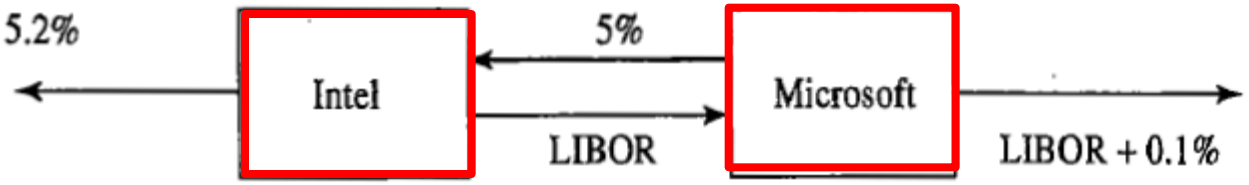
For Intel, the swap could have the effect of transforming a fixed-rate loan into a floating–rate loan.

Suppose, that Intel has a 3-year $100 million loan outstanding on which it pays 5.2%. After it has entered into the swap, it has the following three sets of cash flows:

1. It pays 5.2% to its outside lenders
2. It pays LIBOR under the terms of the swap
3. It receives 5% under the terms of the swap

For Intel, the swap have the effect of transforming borrowings at a fixed rate of 5.2% into borrowings at a floating rate of LIBOR plus 20 basis points.

Microsoft and Intel use the Swap to transform a liability



Using the Swap to Transform an Asset

Swaps can also be used to transform the nature of an asset.

Consider Microsoft in our example.

The swap could have the effect of transforming an asset earning a fixed rate of interest into an asset earning a floating rate of interest.

Suppose Microsoft owns $100 million in bonds that will provide interest at 4.7% per annum over the next 3 years.

After Microsoft has entered into a swap, it has the following three sets of cash flows:

1. It receives 4.7% on the bonds
2. It receives LIBOR under the terms of the swap
3. It pays 5% under the terms of the swap

One possible use of the swap for Microsoft is to transform an asset earning 4.7% into an asset earning LIBOR minus 30 basis points.

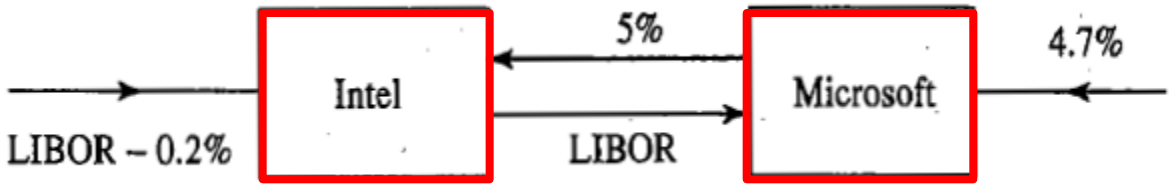
In case of Intel, the swap could have the effect of transforming an asset earning a floating rate of interest into an asset earning a fixed rate of interest.

Suppose that Intel has an investment of $100 million that yields LIBOR minus 20 basis points. After it has entered into the swap, has the following three sets of cash flows:

1. It receives LIBOR minus 20 basis points on its investment
2. It pays LIBOR under the terms of the swap
3. It receives 5% under the terms of the swap

Possible use of swap for Intel is to transform and asset earning LIBOR minus 20 basis points into an asset earning 4.8%.

Microsoft and Intel use the Swap to transform an asset



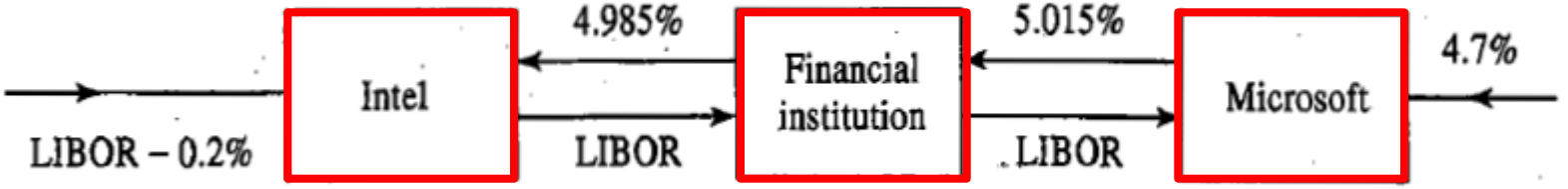
Role of Financial Intermediary

Usually two nonfinancial companies such as Intel and Microsoft do not get in touch directly to arrange a swap.

They each deal with a financial intermediary such as a bank or other financial institution.

"Plain vanilla" fixed-for-floating swaps on US interest rates are usually structured so that the financial institutions earns about 3 or 4 basis points (0.03% or 0.04%) on a pair of offsetting transactions.

Interest rate swap when financial institution is involved



Currency Swaps

Swap that involves exchanging principal and interest payments in one currency for principal and interest in another.

A currency swap agreement requires the principal to be specified in each of the two currencies.

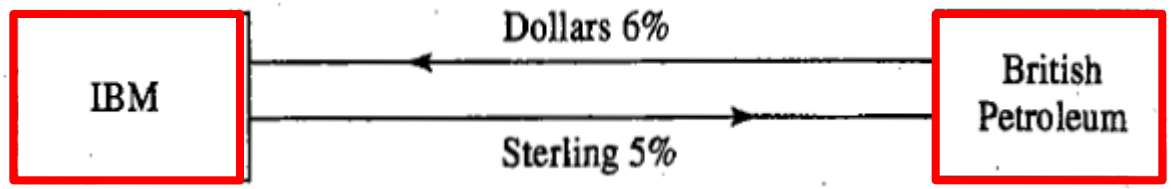
Example:

Consider a hypothetical 5-year currency swap agreement between IBM and British Petroleum entered into on February, 1, 2007.

We suppose that IBM pays a fixed rate of interest of 5% in sterling and receives a fixed rate of interest of 6% in dollars from British Petroleum.

Interest rate payments are made once a year and the principal amounts are $18 million and £10 million.

This is termed a fixed-to-fixed currency swap because the interest rate in both currencies is fixed.



Date	Dollar Cash Flow (millions)	Sterling Cash Flow (millions)
February, 1, 2007	-18.00	+10.00
February, 1, 2008	+1.08	-0.50
February, 1, 2009	+1.08	-0.50
February, 1, 2010	+1.08	-0.50
February, 1, 2011	+1.08	-0.50
February, 1, 2012	+19.08	-10.50

Use of a Currency Swap to Transform Liabilities

A swap can be used to transform borrowings in one currency to borrowings in another.

Suppose IBM can issue $18 million of US-dollar-denominated bonds at 6% interest.

The swap has the effect of transforming this transaction into one where IBM has borrowed £10 million at 5% interest.

The initial exchange of principal converts the proceeds of the bond issue from US dollars to sterling.

The subsequent exchanges in the swap have the effect of swapping the interest and principal payments from dollars to sterling

Use of a Currency Swap to Transform Assets

The swap can also be used to transform the nature of assets.

Suppose that IBM can invest £10 million in the UK to yield 5% per annum for the next 5 years.

However IBM feels the US dollar will strengthen against sterling and prefers US-dollar-denominated investment.

The swap has the effect of transforming the UK investment into a $18 million investment in the US yielding 6%.

Comparative Advantage

Currency swaps can be motivated by comparative advantage.

Suppose the 5-year fixed-rate borrowing costs to General Electric and Qantas Airways in US dollars (USD) and Australian dollars (AUD) are as below:

	USD	AUD
General Electric	5.0%	7.6%
Qantas Airways	7.0%	8.0%

Australian rates are higher than USD interest rates
General Electric is more creditworthy than Qantas Airways

From the viewpoint of a swap trader, the interesting aspect is that the spreads between the rates paid by General Electric and Qantas Airways in the two markets are not the same.

Suppose that General Electric wants to borrow 20 million AUD and Qantas Airways wants to borrow 15 million USD and the current exchange rate (USD per AUD) is 0.7500.

General Electric and Qantas Airways each borrow in the market where they have a comparative advantage.

- General Electric will borrows USD
- Qantas Airways will borrow AUD

They then use a currency swap to transform General Electric's loan into an AUD loan and Qantas Airways' loan into USD loan.

We expect the total gain to all parties to be 2%-0.4%=1.6% per annum

General Electric borrows USD
Qantas Airways borrows AUD

Effect of the swap is to transform the USD interest rate of 5% per annum to an AUD interest rate of 6.9% per annum for General electric.

General Electric is 0.7% per annum better off than it would be if it went directly to AUD markets.

Qantas exchanges an AUD loan at 8% per annum for a USD loan at 6.3% per annum and ends up 0.7% per annum better off than it would be if it went directly to USD markets.

The financial institution gains 1.3% per annum on its USD cash flows and loses 1.1% per annum on its AUD flows.

The financial institution makes a net gain of 0.2% per annum (ignoring the difference between the two currencies).

The total gain to all parties is 1.6% per annum.

Forward Rate Agreements

Forward Rate Agreement: is a contract that specifies a cash payment at contract maturity determined by the difference between an agreed interest rate and the realized interest rate at maturity.

There are FRAs on Eurodollar deposit rates (LIBOR) and FRAs on euro deposit rates (Euribor).

Example:

Consider a one-month FRA contract, expiring in 30 days, based on 3-month LIBOR. The underlying rate on the contract is the 3-month LIBOR that will prevail in 30 days. Suppose the two parties to the contract agree on a fixed rate of 2.5%. The buyer of the FRA will receive a payment from the seller if the actual 3-month LIBOR rate at expiration of the FRA contract is greater than 2.5%. The seller of the FRA will receive a payment from the seller if the actual 3-month LIBOR rate at expiration of the FRA contract is less than 2.5%.

Calculate and Interpret the payoff of a FRA

Two parties agree to make a loan to the other at the maturity of the FRA. They enter in a 30-day FRA contract based on 3-month LIBOR with a FRA (fixed) rate of 2.5% and a notional of $100,000,000.
This is s 1×4 FRA maturing in 1 month, at which time a 3-month loan will be exchanged (a relationship lasting a total of 4 months).

At maturity date (30 days from inception)
The seller of the FRA agrees to make a $100 million loan to the buyer at a rate of 2.5% for three months (buyer pays 2.5% interest to the FRA seller).
The buyer of the FRA agrees to loan the seller $100 million at whatever 3-month LIBOR is at maturity, again for 3 months.

No money actually changes hands at the inception of the FRA.

30 days later, 3 month LIBOR is 2.73%.

$$Interest\ Paid\ by\ FRA\ Buyer = Notional \times \left[Interest\ Rate \times \frac{t_{days}}{360}\right]$$
$$= \$100{,}000{,}000 \times \left[0.0250 \times \frac{90}{360}\right] = \$625{,}000$$

$$Interest\ Paid\ by\ FRA\ Seller = Notional \times \left[Interest\ Rate \times \frac{t_{days}}{360}\right]$$
$$= \$100{,}000{,}000 \times \left[0.0273 \times \frac{90}{360}\right] = \$682{,}500$$

The seller will simply pay the buyer the present value of the difference between the interest payments discounted at the current 3-month LIBOR rate.

$$Payment\ to\ FRA\ Buyer = PV_{LIBOR}\ of\ (Interest\ Owned\ to\ Buyer\ - Interest\ Owned\ to\ Seller)$$

$$Payment\ to\ FRA\ Buyer = \frac{\$682{,}500 - \$625{,}000}{1 + 0.0273 \times \left(\frac{90}{360}\right)} = \$57{,}110.22$$

$$FRA\ Payment = Notional\ Amount \times \frac{(Actual\ Rate - Agreed\ Rate)(t_{days}/360)}{1 + Actual\ Rate(t_{days}/360)}$$

Currency Forward Agreements

Currency forwards involve two parties who agree to exchange currencies at a future date and specified exchange rates.

Example:
Bank A agrees to buy £50,000,000 in six months from Bank B who agrees to sell the pounds at \$1.10/ £. If, in six months, the actual exchange rate is only \$1.05/ £, Bank A will suffer a loss of \$2.5 million.
Gain or loss calculation:

$$Gain\ or\ Loss\ on\ Forward\ Contract = (Actual\ Exchange\ Rate - Contract\ Exchange\ Rate) \times Notional$$

$$= (\$1.05/£ - \$1.10/£) \times -50{,}000{,}000 = -\$2{,}500{,}000$$

Bank B on the other hand will make a profit of \$2.5 million, because it can buy the £50,000,000 in the spot market at \$1.05/ £ and sell it to Bank B at at \$1.10/ £.

A forward agreement is a zero-sum game.