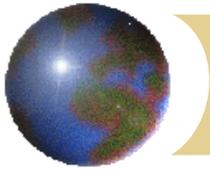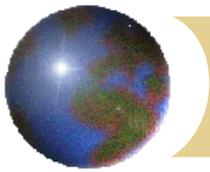# *Swaps*

Nature of Swaps

A swap is an agreement to exchange cash flows at specified future times according to certain specified rules

An Example of a "Plain Vanilla" Interest Rate Swap

- An agreement by Apple to receive 6-month LIBOR & pay a fixed rate of 3% per annum every 6 months for 3 years on a notional principal of $100 million
- Next slide illustrates cash flows that could occur (Day count conventions are not considered)
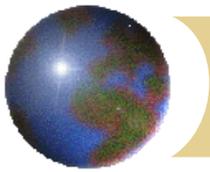
Cash Flows to Apple
(See Table 7.1, page 157

| Date	LIBOR Rate	*FLOATING* Cash Flow	*FIXED* Cash Flow	Net Cash Flow
		--------Millions of Dollars--------		
Mar. 8, 2016	2.2%			
Sept. 8, 2016	2.8%	+1.10	−1.50	−0.40
Mar. 8, 2017	3.3%	+1.40	−1.50	−0.10
Sept. 8, 2017	3.5%	+1.65	−1.50	+0.15
Mar. 8, 2018	3.6%	+1.75	−1.50	+0.25
Sept. 8, 2018	3.9%	+1.80	−1.50	+0.30
Mar. 8, 2019	3.4%	+1.95	−1.50	+0.45
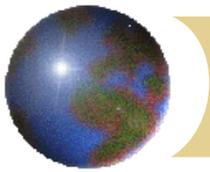
Typical Uses of an Interest Rate Swap

- Converting a liability from
  - fixed rate to floating rate
  - floating rate to fixed rate

- Converting an investment from
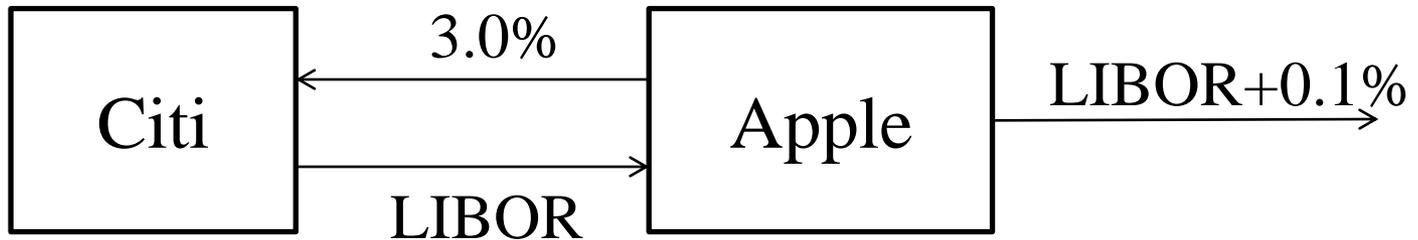 - fixed rate to floating rate
  - floating rate to fixed rate
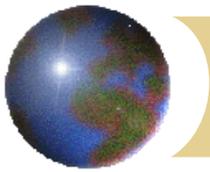
Interest Rate Swap Between Apple and Citigroup (Figure 7.1, page 156)
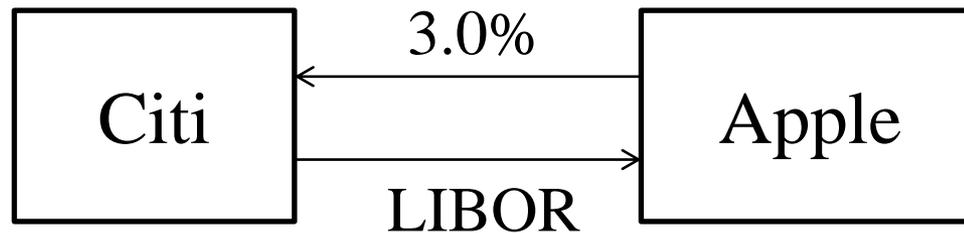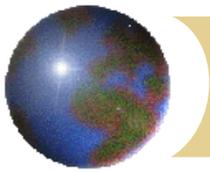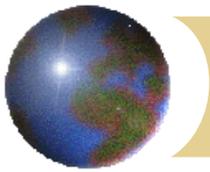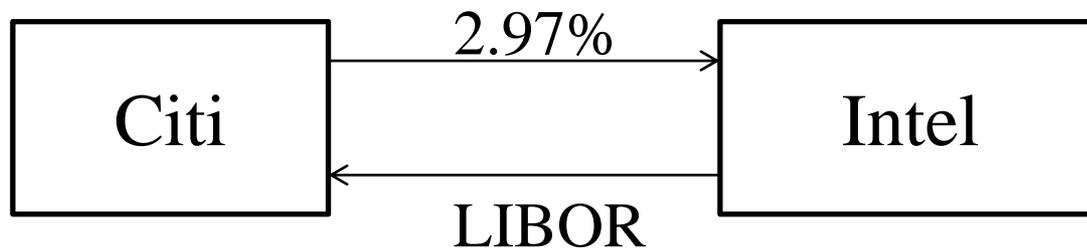
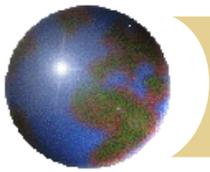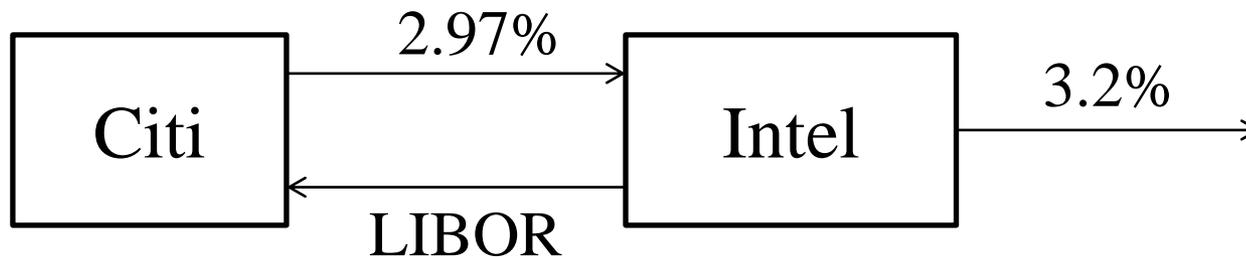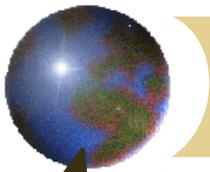# *Apple Transforms a Liability from Floating to Fixed*
(Figure 7.2, page 158)

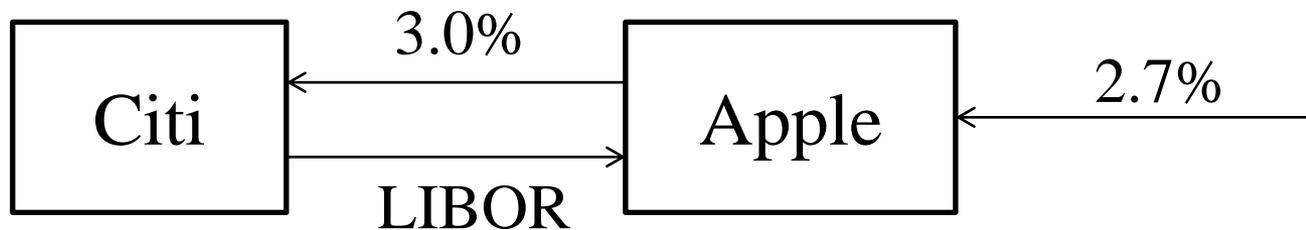# *Interest Rate Swap Between Citigroup and Intel* *(Figure 7.3, page 159)*

Intel Transforms a Liability from Fixed to Floating (Figure 7.4, page 159)

Apple Transforms an Asset from Fixed to Floating (Figure 7.5, page 159)
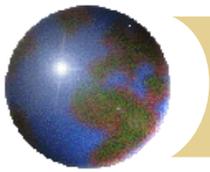
Intel Transforms an Asset from Floating to Fixed *(Figure 7.6, page 160)*
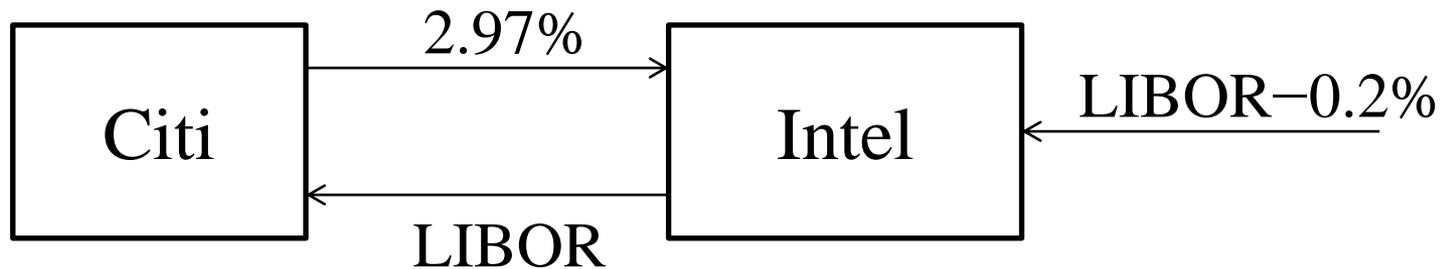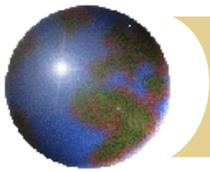
Quotes By a Swap Market Maker *(Table 7.3, page 161)*

Maturity	Bid (%)	Offer (%)	Swap Rate (%)
2 years	2.55	2.58	2.565
3 years	2.97	3.00	2.985
4 years	3.15	3.19	3.170
5 years	3.26	3.30	3.280
7 years	3.40	3.44	3.420
10 years	3.48	3.52	3.500
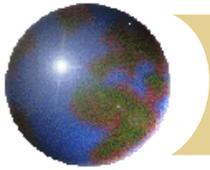
Day Count

- A day count convention is specified for fixed and floating payments

- For example, LIBOR is likely to be actual/360 in the U.S. because LIBOR is a money market rate
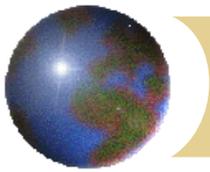
Confirmations

- Confirmations specify the terms of a transaction
- The International Swaps and Derivatives has developed Master Agreements that can be used to cover all agreements between two counterparties
- CCPs are used for most standard swaps between two financial institutions
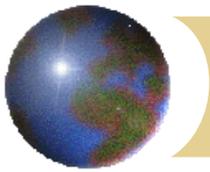
The Comparative Advantage Argument
(Table 7.4, page 163)

- ⊕ AAACorp wants to borrow floating
- ⊕ BBBCorp wants to borrow fixed

	Fixed	Floating
AAACorp	4.00%	6-month LIBOR − 0.1%
BBBCorp	5.20%	6-month LIBOR + 0.6%
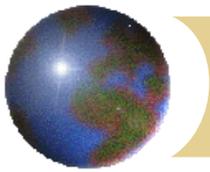
A Swap where Companies Trade Directly with Each Other *(Figure 7.7, page 164)*

4% ← AAACorp —4.35%→ (from BBBCorp) ... LIBOR → BBBCorp → LIBOR+0.6%
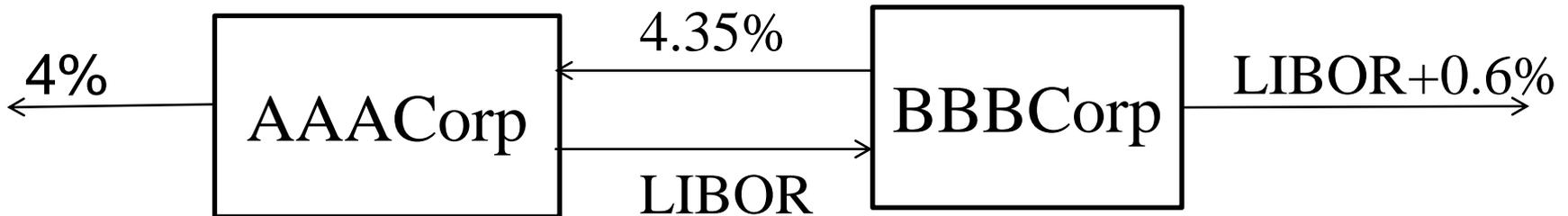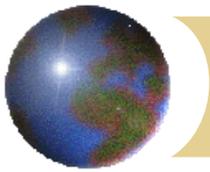
The Swap when a Financial Institution (F.I.) is Involved
(Figure 7.7, page 164)
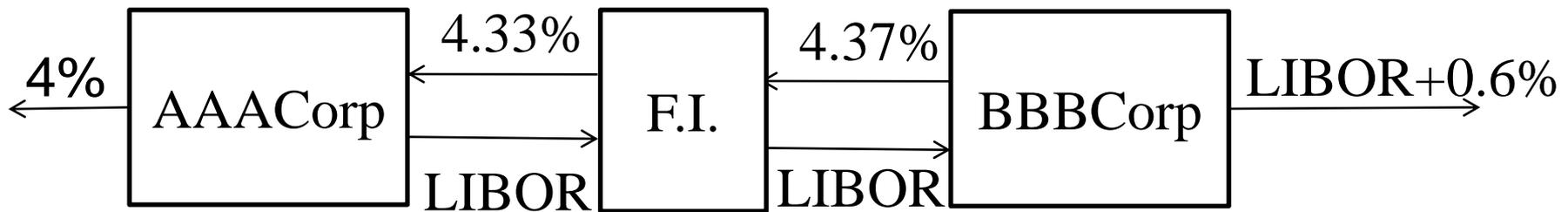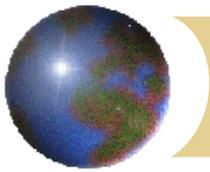
Criticism of the Comparative Advantage Argument

- The 4.0% and 5.2% rates available to AAACorp and BBBCorp in fixed rate markets are 5-year rates

- The LIBOR−0.1% and LIBOR+0.6% rates available in the floating rate market are six-month rates

- BBBCorp's fixed rate depends on the spread above LIBOR it borrows at in the future
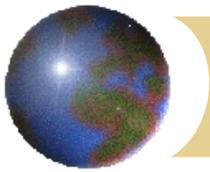
Valuation of an Interest Rate Swap

- Initially interest rate swaps are worth close to zero

- At later times they can be valued as a portfolio of forward rate agreements (FRAs)

- The procedure is to

  - Calculate LIBOR forward rates

  - Calculate the swap cash flows that will occur if LIBOR forward rates are realized

  - Discount these swap cash flows at OIS rates
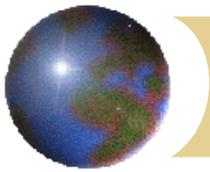
Example 7.1 *(page 166)*

- Swap involves paying 3% per annum and receiving LIBOR every six months on $100 million

- Swap has 15 months remaining (exchanges in 3, 9, and 15 months)

- LIBOR rate applicable to exchange in 3 months was determined 3 months ago and is 2.9%

- Forward LIBOR rates for 3-9 month period and 9-15 month periods are 3.429% and 3.734%, respectively

- OIS zero rates for maturities of 3, 9, and 15 months are 2.8%, 3.2%, and 3.4%, respectively
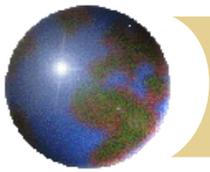
Calculations ($ million)

Time (yrs)	Fixed cash flow	Floating cash flow	Net cash flow	Discount factor	PV of net cash flow
0.25	−1.5000	+1.4500	−0.0500	0.9930	−0.0497
0.75	−1.5000	+1.7145	+0.2145	0.9763	+0.2094
1.25	−1.5000	+1.8672	+0.3672	0.9584	+0.3519
					+0.5117

Value of swap is $0.5117 million
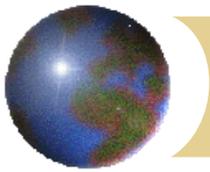
Bootstrapping LIBOR forward rates: Example 7.2 (page 167)

- 6,12,18, and 24 month OIS rates are 3.8%, 4.3%, 4.6%, and 4.75% respectively with cont. comp.

- 6-month LIBOR rate is 4% (sa comp.)

- Suppose forward LIBOR rates for 6-12 and 12-18 months have already been calculated as 5% and 5.5%, respectively (sa comp)

- The two year swap rate is 5%

- The next step is to calculate the LIBOR forward rate, F, for the18-24 month period.
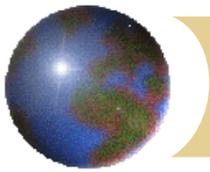
Bootstrapping LIBOR forward rates: Calculations

- A 2-year swap where 5% is paid and LIBOR is received on $100 is worth zero.

- Value of first three exchanges are

$$0.5\times(0.04-0.05)\times100\times e^{-0.038\times0.5} = -0.4906$$
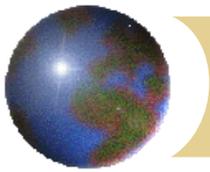$$0.5\times(0.05-0.05)\times100\times e^{-0.043\times1.0} = 0$$
$$0.5\times(0.055-0.05)\times100\times e^{-0.046\times1.5} = +0.2333$$

- The value of the fourth payment must be +0.2573 so that the total value is zero

$$0.5\times(F-0.05)\times100\times e^{-0.0475\times2.0} = 0.2573$$

$$F = 0.05566 \text{ or } 5.566\% \text{ per annum}$$

An Example of a Fixed-for-Fixed Currency Swap (Figure 7.10, page 169)

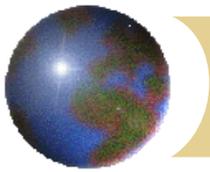Five year agreement by BP to

- Pay 3% on a US dollar principal of $15,000,000

- Receive 4% on a sterling principal of £10,000,000
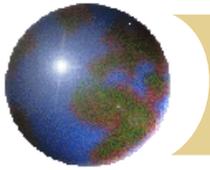
Exchange of Principal

- In an interest rate swap the principal is not exchanged

- In a currency swap the principal is exchanged at the beginning and the end of the swap

The Cash Flows *(Table 7.5, page 170)*

Date	Dollar Cash Flows (millions)	Sterling cash flow (millions)
Feb 1, 2016	+15.00	−10.00
Feb 1, 2017	−0.45	+0.40
Feb 1, 2018	−0.45	+0.40
Feb 1, 2019	−0.45	+0.40
Feb 1, 2020	−0.45	+0.40
Feb 1, 2021	−15.45	+10.40
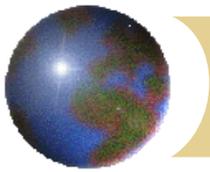
Typical Uses of a Currency Swap

- Conversion from a liability in one currency to a liability in another currency

- Conversion from an investment in one currency to an investment in another currency
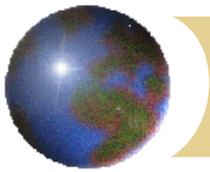
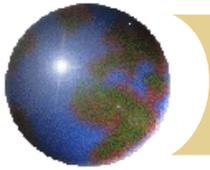# *Comparative Advantage May Be Real Because of Taxes*

- General Electric wants to borrow AUD

- Quantas wants to borrow USD

Borrowing costs after adjusting for the differential impact of taxes could be:

|	USD	AUD
General Electric	5.0%	7.6%
Quantas	7.0%	8.0%

Valuation of Fixed-for-Fixed Currency Swaps

Fixed for fixed currency swaps can be valued either using forward rates or as the difference between 2 bonds
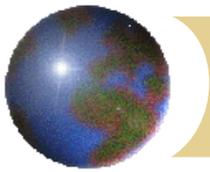
Examples 7.3 and 7.4 *(pages 172-174)*

- All Japanese interest rates are 1.5% per annum (cont. comp.)
- All USD interest rates are 2.5% per annum (cont. comp.)
- 3% is received in yen; 4% is paid in dollars. Payments are made annually
- Principals are $10 million and 1,200 million yen
- Swap will last for 3 more years
- Current exchange rate is 110 yen per dollar
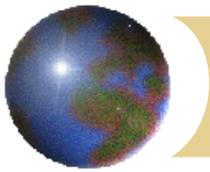
Valuation in Terms of Forward Rates *(page 173)*

| Time	Dollar Cash Flow	Yen cash flow	Forward rate	Dollar value of yen cash flow	Net cash flow	Present value
1	−0.4	+36	0.009182	0.3306	−0.0694	−0.0677
2	−0.4	+36	0.009275	0.3339	−0.0661	−0.0629
3	−10.4	+1236	0.009368	11.5786	+1.1786	+1.0934
Total						+0.9629
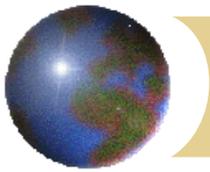
Valuation in Terms of Bonds
(page 174)

| Time	Cash Flows ($ millions)	PV ($ millions)	Cash flows (millions of yen)	PV (millions of yen)
1	0.4	0.3901	36	35.46
2	0.4	0.3805	36	34.94
3	10.4	9.6485	1,236	1,181.61
Total		10.4191		1,252.01

Value = 1,252.01/110−10.4191 = +0.9629 millions of dollars
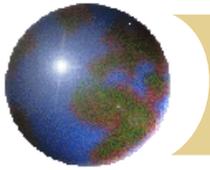
Other Currency Swaps

- Fixed-for-floating: equivalent to a fixed-for-fixed currency swap plus a fixed for floating interest rate swap

- Floating-for-floating: equivalent to a fixed-for-fixed currency swap plus two floating interest rate swaps
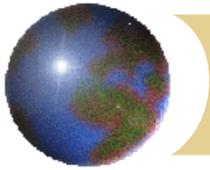
Swaps & Forwards

- A swap can be regarded as a convenient way of packaging forward contracts

- When a swap is initiated the swap has zero value, but typically some forwards have a positive value and some have a negative value
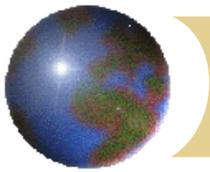
Credit Risk

- When derivatives transactions with a counterparty are cleared bilaterally, they are netted

- There is exposure if the net value of outstanding transactions is greater than the collateral posted
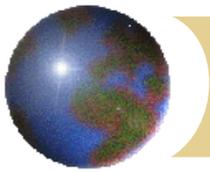
Credit Default Swaps: A Quick First Look

- Notional principal (e.g. $100 million) and maturity (e.g. 5 yrs) specified

- Protection buyer pays a fixed rate (e.g. 150 bp) on the notional principal (the CDS spread)

- If the reference entity (a country or company) defaults protection seller buys bonds issued by the reference entity for their face value and the spread payments stop. Total face value of bonds bought equals notional principal
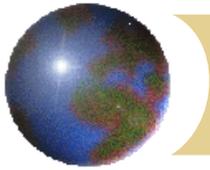
Other Types of Swaps

- Amortizing/ step up
- Compounding swap
- Constant maturity swap
- LIBOR-in-arrears swap
- Accrual swap
- Equity swap
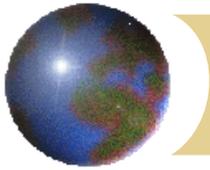
Other Types of Swaps *continued*

- Cross currency interest rate swap
- Floating-for-floating currency swap
- Diff swap
- Commodity swap
- Variance swap