3. Swaps
What is a Swap?

A swap is an agreement to exchange cash flows in the future according to specified rules.
Plain Vanilla and Currencies

• Cash flows can be positive (investment) or negative (liability).

• In a plain vanilla swap, the exchange is between fixed (e.g. 5%) and floating (e.g., LIBOR) interest rates.

• In a currency swap, the exchange is between a fixed rate on a currency (e.g., 11% on £10 million) and a fixed rate on another currency (e.g., 8% on US$15 million).
Example of a Plain Vanilla Swap

(Hull) Microsoft agrees to receive 6-month LIBOR and to pay 5% per annum every 6 months for 3 years on a notional principal of $100 million.
Example of a Currency Swap

(Hull) IBM agrees to pay 11% on principal of £10 million and to receive 8% on a principal of US$15 million every year for 5 years.
Principal

• Not exchanged (notional) in a plain vanilla swap

• Exchanged at the beginning and at the end in a currency swap
Example of a Plain Vanilla Swap to Transform a Liability

(Hull) A is currently paying 5.2% to creditors. B is currently paying LIBOR + 0.8% to creditors. A agrees to swap LIBOR for 5% with B. What are A’s and B’s net interest rate outflows?
Example of a Plain Vanilla Swap to Transform an Investment

(Hull) A is currently receiving LIBOR – 0.25% from its investment. B is currently receiving 4.7% from its investment. A agrees to swap LIBOR for 5% with B. What are A’s and B’s net interest rate inflows?
The Intermediary

• When a financial institution is involved, it takes a cut for its services (typically 0.03%).

• The financial institution may warehouse a swap until a counterparty is found.

• The financial institution absorbs the credit risk.
Comparative Advantage Argument of a Plain Vanilla Swap

- $A$ wants to borrow floating
- $B$ wants to borrow fixed
- but

<table>
<thead>
<tr>
<th></th>
<th>Fixed</th>
<th>Floating</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A$</td>
<td>10%</td>
<td>LIBOR + 0.3%</td>
</tr>
<tr>
<td>$B$</td>
<td>11.2%</td>
<td>LIBOR + 1%</td>
</tr>
</tbody>
</table>
Do you Believe It?

No:

Floating rates are typically reset every six months while fixed rates are fixed for the time period of the swap.

Fixed rates reflect the future expected floating rates.

Lenders have the opportunity to review the spread over LIBOR.

Thus, any comparative advantage at the beginning the swap is expected to later become a “comparative disadvantage”.
Comparative Advantage Argument of a Currency Swap

- A wants to borrow British £
- B wants to borrow US $
- but

<table>
<thead>
<tr>
<th></th>
<th>$</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8%</td>
<td>11.6%</td>
</tr>
<tr>
<td>B</td>
<td>10%</td>
<td>12%</td>
</tr>
</tbody>
</table>
Do you Believe It Now?

Yes:

Lenders may have better information about home corporations than foreign ones.
Credit Risk

• Like it says, you only incur this risk when the other party owes you cash flows.

• I.e., when the value of your swap is positive.

• The initial value of a swap is always zero, but can become positive or negative after that time.
Valuing a Plain Vanilla Swap

• By the difference between the value of fixed-rate bond and the value of a floating-rate bond

• As a portfolio of forward rate agreements
What is a FRA?

A FRA is an agreement that

• a certain interest rate will apply
• to a certain principal
• over a certain period in the future.
What is the forward rate?

The forward rate $r_F$ can be expressed in terms of the zeros rates $r_1$ and $r_2$

$$e^{r_1 t_1}e^{r_F(t_2-t_1)} = e^{r_2 t_2}$$

$$e^{r_1 t_1}+r_F(t_2-t_1) = e^{r_2 t_2}$$

$$r_1 t_1 + r_F(t_2 - t_1) = r_2 t_2$$

$$r_F = \frac{r_2 t_2 - r_1 t_1}{t_2 - t_1}$$
Valuing Bonds

• You know how to value a fixed-rate bond!

\[ B_{fx} = \sum_i k e^{-r_i t_i} + Q e^{-r_{ntn}} \]

• Remember that a floating-rate bond is reset at par immediately after each payment date.

\[ B_{fl} = (k^* + Q)e^{-r_{1t1}} \]
Example of a Plain Vanilla Swap

(Hull) A financial institution has agreed to pay 6-month LIBOR and receive 8% per annum (with semi-annual compounding) on a notional principal of $100 million. The swap has a remaining life of 15 months. The discount rates (with continuous compounding) for 3-month, 9-month, and 15-month, are 10%, 10.5%, and 11% per annum respectively. The 6-month LIBOR rate at the last payment was 10.2% (with semi-annual compounding). What is the value of the swap to the financial institution?
Valuing a Currency Swap

• By the difference between the value of a domestic bond and the value of a foreign bond

• As a portfolio of forward contracts
(Hull) A financial institution has agreed to receive 5% per annum on 1,200 million yens and to pay 8% per annum on $10 million (with annual compounding). The swap will last for another three years and the current exchange rate is 110 yens/$. The Japanese and U.S. interest rates for all maturities are respectively 4% and 9% per annum (with continuous compounding). What is the value of the swap to the financial institution?
Homework

1. (Baby Hull 7.10, Papa Hull 7.9) Companies X and Y have been offered the following rates per annum on a $5 million 10-year investment:

<table>
<thead>
<tr>
<th>Company</th>
<th>Fixed Rate</th>
<th>Floating Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>8%</td>
<td>LIBOR</td>
</tr>
<tr>
<td>Y</td>
<td>8.8%</td>
<td>LIBOR</td>
</tr>
</tbody>
</table>

Company X requires a fixed-rate investment; company Y requires a floating-rate investment. Design a swap that will net a bank, acting as intermediary, 0.2% per annum and that will appear equally attractive to X and Y.

2. (Hull 7.20) Company A, a British manufacturer, wishes to borrow U.S. dollars at a fixed rate of interest. Company B, a U.S. multinational, wishes to borrow sterling at a fixed rate of interest. They have been quoted the following rates per annum (adjusted for tax effects):

<table>
<thead>
<tr>
<th>Company</th>
<th>Sterling</th>
<th>U.S. Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11%</td>
<td>7%</td>
</tr>
<tr>
<td>B</td>
<td>10.6%</td>
<td>6.2%</td>
</tr>
</tbody>
</table>

Design a swap that will net a bank, acting as intermediary, 10 basis points per annum and that will produce a gain of 15 basis points per annum for each of the two companies.

3. (Hull 7.21) Under the terms of an interest-rate swap, a financial institution has agreed to pay 10 percent per annum and to receive three-month LIBOR in return on a notional principal of $100 million with payments being exchanged every three months. The swap has a remaining life of 14 months. The average bid-ask fixed rate currently being swapped for three-month LIBOR is 12 percent per annum for all maturities. The three-month LIBOR one month ago was 11.8 percent per annum. All rates are compounded quarterly. What is the value of the swap?