## INTEREST RATE SWAPS

September 1999

## INTEREST RATE SWAPS

## Definition:

## Transfer of interest rate streams without transferring underlying debt.

## FIXED FOR FLOATING SWAP

## Some Definitions

Notational Principal:

Reset Period:

The dollar the interest rates apply to.

Period over which the coupon is fixed. By tradition fixed rate payer has sold swap, floating rate payer has bought swap.

Example fixed for floating swap:

1. A pays B8\% fixed
2. B pays A six-month $T$ bill rate $+\mathbf{2 \%}$ floating
3. Time three years
4. Notational Principal one million

## PERIOD T-BILL RATE $\underline{\text { A }}$

| $\mathbf{0}$ | $\mathbf{4}$ |  |  |
| :--- | :--- | :--- | :--- |
| $\mathbf{1}$ | $\mathbf{3}$ | $\mathbf{3 0 , 0 0 0}$ | $\mathbf{4 0 , 0 0 0}$ |
| 2 | $\mathbf{4}$ | $\mathbf{2 5 , 0 0 0}$ | $\mathbf{4 0 , 0 0 0}$ |
| $\mathbf{3}$ | $\mathbf{5}$ | $\mathbf{3 0 , 0 0 0}$ | $\mathbf{4 0 , 0 0 0}$ |
| $\mathbf{4}$ | $\mathbf{7}$ | $\mathbf{3 5 , 0 0 0}$ | $\mathbf{4 0 , 0 0 0}$ |
| 5 | $\mathbf{8}$ | $\mathbf{4 5 , 0 0 0}$ | $\mathbf{4 0 , 0 0 0}$ |
| $\mathbf{6}$ |  | $\mathbf{5 0 , 0 0 0}$ | $\mathbf{4 0 , 0 0 0}$ |

## SOME VALUATION PRINCIPALS

Ignore risk for moment
Although principal not traded equivalent to selling a fixed for floating bond of one million since this one million cancels out.

At initiation, both sides must be happy. Thus price of fixed and floating must be same. Since floating is at par, rate on fixed must equal rate on three-year Treasury.

Duration fixed > Duration of floating Therefore, if rates increase, person receiving floater better off. If rates decline, want to receive fixed.

If no change in yield curve and upward sloping yield curve, payer of floating has positive value over its early life.

## Equivalent Swap

# 1. $T$-bill $+\mathbf{1 \%}$ for fixed. <br> 2. T-bill for fixed minus $\mathbf{1 \%}$. 

## Example:

## T-bill + $1 \%$------------> <br> <------------ 10\% <br> can be valued as <br> T-bill -----------> <br> <----------- 9\%

## GENERAL SWAP VALUATION

1. Obtain spot rates.
2. Treat fixed rate as fixed rate coupon minus any floating spread. Discount at spots to get present value.
3. Since floating is par when reset treat floating as if bond maturing at reset date and discount cash flows at appropriate spot get present value.

## Example:

1. Pay rate on six-month T-bill as of beginning of period.
2. Receive $8 \%$ (semi-annual) fixed.
3. Remaining life $\mathbf{1 8}$ months.
4. Notational principal 100 million.
5. Spot rates $10,10.5,11$
6. Rate on floater $\mathbf{4 . 8 8}$

## VALUE OF A SWAP

Swaps can be valued:
Difference of two bonds:
Let,
$V=\quad$ Value of swap
$B_{1}=\quad$ Value of fixed rate underlying the swap
$B_{2}=\quad$ Value of floating rate bond underlying the swap
$Q=\quad$ Notational principal in the swap agreement
$C=\quad$ Fixed cash flow
$U=\quad$ First cash flow on variable
It follows that:

$$
\begin{gathered}
V=B_{1}-B_{2} \\
B_{1}=\sum_{i=1}^{N} \frac{C}{\left(1+\frac{r_{o t}}{2}\right)^{i}}+\frac{Q}{\left(1+\frac{r_{O N}}{2}\right)^{N}} \\
B_{2}=\frac{U}{\left(1+\frac{r_{01}}{2}\right)}+\frac{Q}{\left(1+\frac{r_{01}}{2}\right)}
\end{gathered}
$$

$$
\begin{aligned}
\text { Value fixed } & =\frac{4}{(1.05)}+\frac{4}{(1.0525)^{2}}+\frac{104}{(1.055)^{3}} \\
& =95.99
\end{aligned}
$$

$$
\text { Value variable }=\frac{104.88}{(1.05)}=99.89
$$

$$
\begin{aligned}
\text { Value swap } & =\text { fixed }- \text { variable } \\
& =\mathbf{- 3 . 9 0}
\end{aligned}
$$

- View as futures contracts.
- Series of futures contract on six-month LIBOR. Value these contracts.


## LIBOR

Usually floating is pegged to LIBOR (London Interbank Offer Rate)

LIBOR has credit risk. Thus it has a spread over T-bill rates, usually about $\mathbf{1 / 2 \%}$. Considered an AA risk.

Therefore, if initial value of swap is to be zero, the fixed rate must also exceed rate on default-free Treasuries.

## INSTITUTIONAL FACTORS

It is evident that a swap is equivalent to an exchange of bonds. Given the fact that swaps are carried out between corporate entities, they should display all the features of corporate bonds. However, this is usually not the case. Litzenberger (Journal of Finance, 1992) points out that there are three features of difference between swaps and exchange of pure corporate bonds:

1. Bid-Ask spreads are far less than on corporate bonds, and even governments in most cases. Swap spreads are around 5 bps, the lowest in any market.
2. Swap spreads (the difference between the fixed and floating leg) do not display the volatile cyclical behavior of corporate bond spreads.
3. The quoted swap rates do not reflect credit rating differences between counterparties.

We call these "credit risk anomalies."

## RISK AND SWAPS

1. Since principal is not swapped, maximum loss much less than on bond.
2. Therefore, if risky corporation would normally need to pay 3\% over Treasuries for swap, need to pay much less.
3. Loss is value of swap at default.
4. If floating payer is defaulter, then fixed rate payer

Losses: if rates increased
Gains: if rates decreased
5. Note: May gain or lose with default.
6. Many swap deals have clause that swap is settled if one party's credit downgraded.
7. Many institutions have subsidiary that in essence insures against default.

## MOTIVATIONS FOR SWAP

1. Adjust duration
2. Overcome restrictions
3. Interest rate bets
4. Managing basis risk
5. Comparative advantage
a. Arbitrage
b. Differential information and restrictions

## MANAGING DURATION

Why use swaps to manage Duration Risk?

1. Many institutions such as federal agencies are restricted or disallowed to trade in futures.
2. Swap costs are low.
3. Swaps can be tailored to meet needs where futures are more standardized.

## COMPARATIVE ADVANTAGE

- The average quality spreads between Aaa and Baa in the fixed rate corporate bond market are 50-100 basis points.
- Spread in the floating rate markets =50 bps.

Why do such differences in spreads exist? This is because credit risk is also a function of time to maturity of a bond. We have also seen that swaps are less sensitive to credit risk aspects.

This swap technique is often evidenced when a firm expect its credit rating to improve. Then it finds that it can obtain wellpriced floating rate loans, and hence will prefer to access them in lieu of fixed rate debt. Swapping is a way out. The following example is an extremely common type of such financial engineering:

Why might this make sense?

- Comparative advantage
A.
Fixed
Floating
Libor + 1.5
B. $\quad 9$
Libor + 2
Lower
- A wants floating and B wants fixed


## Example of Lowering Fixed Rate Costs:

Baa corporate borrows at floating rate $=T-b i l l+0.5 \%$
Aaa corporate borrows at floating rate $=T-$ bill $+.25 \%$
Quality spread for five years maturity $=\mathbf{1 . 5 \%}$
Baa corporate borrows at fixed rate $=\mathbf{1 3 . 0 \%}$
Aaa corporate borrows at fixed rate $=11.5 \%$
Spread Differential = 1.25\%

The swap is depicted in *** Figure 3 ***

Method:

1. Aaa issues bond at $11.5 \%$
2. Enters into swap with Baa to receive fixed $12 \%$ and pay floating six-month T-bill rate.

Net Cost of Funds:
Aaa: T-bill - 0.5\% (gains = 75 bps)
Baa: 12.5\% (gains = 50 bps )

Result:
Credit Risk Arbitrage (the total gain of $\mathbf{1 2 5} \mathbf{b p s}$ is equal to the captured spread differential)

Figure 3

## Fixed/Floating Rate Swap

|  | 12\% |  |
| :---: | :---: | :---: |
| Baa Corporation |  | Aaa <br> Corporation |
| T-bill + 1/2\% |  | 11 1/2\% |
| (Floating-rate |  | (Fixed-rate |
| Market) |  | Market) |

In fixed/floating rate swap, the Baa corporation raises funds in a floating-rate market and promises to pay the Aaa corporation a fixedrate interest, while the Aaa corporation raises funds in a fixed-rate market and promises to pay the Baa corporation a floating-rate interest.

## OTHER SWAPS

(floating/floating)

## MANAGING BASIS RISK

Basis risk arises from unequal changes in floating rates in two separate markets, e.g., LIBOR vs. CD rates.

Here we used a floating-floating swap to hedge away this risk.

## Example:

A bank has an asset yielding LIBOR+0.75\%, and is funded by a liability at T-bill $\mathbf{- 0 . 2 5 \%}$. A counterparty has floating-rate funds at
LIBOR-0.25\%.

The Swap:
Bank pays floating at LIBOR (6 month), receives T-bill+0.5\% (reset weekly).
*** See Figure 4 ***

Figure 4

## Floating/Floating Rate Swap

Asset Yield<br>(LIBOR + 3/4\%



CD
(T-bill-1/4\%)

LIBOR Funding
(LIBOR-1/4\%)

In a floating/floating rate swap, the bank raises funds in the Tbill rate market and promises to pay the counterparty a periodic interest based upon the LIBOR rate, while the counterparty raises funds in the LIBOR rate market and promises to pay the bank a periodic interest based upon the Tbill rate.

## CURRENCY SWAP (Eliminating Currency Risk)

- Exchange fixed for fixed in different currencies.
- Comparative advantage:
Dollars Pounds
A.
8
10
B.
10
11
- Note 1\% difference.
- Assume A wishes to borrow in pounds, B in dollars.

Dollars
A
8

Pounds
11

Pounds 11
9 1/2 Dollars

## SIGNALLING

This play is also often called "Synthetic Fixed Rate Financing."

This arises in an asymmetric information environment. Firms have a better idea of their credit risk levels, and often need a credible way to convey this to the market. This is called "signaling." Signaling must be credible, which basically means that false signals will be punished by the market, hence only true signals will occur in equilibrium.

The method is to signal good credit levels by borrowing floating debt short-term and swapping out to fixed rate financing. A firm will only do this when it knows that its prospects are improving and by going floating it will access better and better rates in the future. The market will also recognize this and be willing to offer better rates today itself, provided it is sure that the firm is not bluffing. The firm is strongly dissuaded from doing so because if next period it is found that its credit is not improving, the market will downgrade its credit by more than usual.

## COMPLEX SWAPS

- Extendable Swaps

Embedded option to extend maturity -- analogous to an option on a forward bond.

- Off-Market Swaps

When the rates at which the two legs are closed are off market. Reason: Usually for rearrangement of income flows (tax purposes).

- Basis Swaps

Floating-Floating swaps

- Amortizing Swaps

Decreasing principal

- Step-Up Swap

Increasing principal

- Deferred Swap

Forward start

- Circus Swap

Cross currency fix-flo

