SWAP MATH:
Understanding Synthetic Rates and Payment Netting

Ernest A. Goetz, Jr. and Kenneth A. Hoffmann

I. Introduction

Many bank customers and even bankers do not understand some of the mathematical concepts which underlie interest rate Swaps. Swap transactions are frequently explained as the exchange of a fixed rate for a floating rate or vice versa. This abbreviated description obscures the complexities of the actual determination of the synthetic all-in rate for a Swap transaction, and masks the effect of the exchange of payment streams effectuated by the netting process (discussed below). This article is an explanation of the concepts and the math involved in simple interest rate Swap transactions, sometimes called "plain vanilla" Swaps. This article will focus on plain vanilla Swaps tied to a borrowing transaction.

II. Background

The Basics of Interest Rate Swaps

An interest rate Swap is a contract pursuant to a written agreement, typically the ISDA Master Agreement, between two parties, often referred to as "counterparties". The counterparties agree to exchange interest rate payments on a specified principal amount, for a fixed period of time. In an interest rate Swap, the principal amount is not actually exchanged by the counterparties and therefore is referred to as the "notional amount".

The payments exchanged in connection with an interest rate Swap are based on (1) the notional principal amount, (2) the applicable interest rates being exchanged, and (3) the interest rate period (usually monthly for LIBOR). The counterparties to the Swap agree to exchange interest payments on specific dates, according to a predetermined schedule. Exchanges typically cover periods ending on loan payment dates.

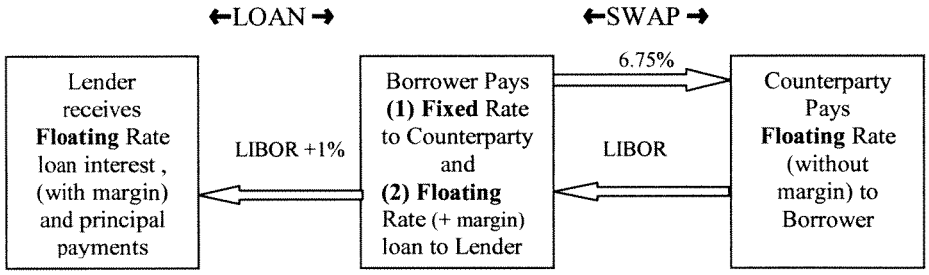
The fixed and floating payment streams are "netted" against each other on the payment date: the party with the larger payment obligation pays the net amount by which its obligation exceeds the obligation to the other party.

Interest rate Swaps have the effect of converting one interest rate basis to a different interest rate basis (e.g., from a floating interest rate basis to a fixed interest rate basis, or vice versa), thereby allowing a Borrower to obtain a synthetic fixed or floating rate.

A floating to fixed rate Swap (diagrammed in *Figure 1* below) allows a Borrower with floating rate debt to hedge its interest rate exposure in a

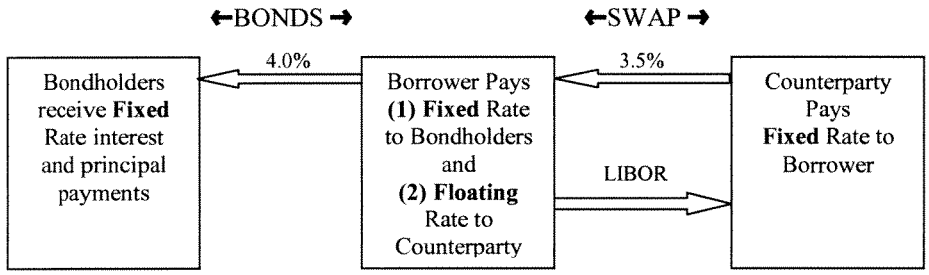
rising rate environment by receiving a floating rate in exchange for paying a fixed rate, thus decreasing the fluctuation of Borrower's future net debt service payments, after giving effect to the Swap and netting the Swap and loan interest payments.

Figure 1 – Swap Diagram for a Floating-to-Fixed Rate Swap



A fixed to floating rate Swap (diagrammed in *Figure 2* below) allows a Borrower with fixed rate debt to take advantage of floating interest rates, typically in a declining interest rate environment. The Borrower's net debt service payments will be lower if the floating Swap rate paid by Borrower to the Swap provider remains below the fixed Swap rate received by the Borrower from the Swap provider. Or stated another way, the Borrower's receipt of a fixed rate in return for payment of a presumably falling floating rate will result in lower net debt service payments.

Figure 2 – Swap Diagram for a Fixed –to- Floating Rate Swap



III. Examples of Plain Vanilla Interest Rate Swaps

Example 1: Floating to Fixed Rate Swap

Charlie Corp. has secured a large widget order and accordingly needs financing; it borrows a $10,000,000 floating rate loan from American Bank, N.A. The floating rate loan initially bears interest at 6% which is equal to the sum of one month LIBOR (which is 5% in this example) plus a margin of 1%, which rate can change monthly with changes in the

one month LIBOR rate. Charlie Corp. then enters into a Swap contract with American Bank, N.A.'s securities affiliate, Cheryl Clinch, Inc. (the "counterparty"). Under the Swap contract, Charlie Corp. agrees to pay the counterparty a fixed interest rate of 6.75%, and the counterparty agrees to pay Charlie Corp. a floating rate equal to one month LIBOR. Both payment streams assume a notional amount of $10,000,000. The net effect of the Swap is that Charlie Corp. has synthetically converted its floating rate obligation to a fixed rate obligation.

Example 2: Fixed to Floating Rate Swap

The widget business is booming and Charlie Corp. decides to build a new widget factory. Cheryl Clinch, Inc. arranges a private placement of $10,000,000 of Charlie Corp. fixed rate bonds at a 4% rate. Charlie Corp. then enters into a Swap contract with Cheryl Clinch Inc., as counterparty. Under the Swap contract, Charlie Corp. agrees to pay the counterparty a floating rate equal to one month LIBOR, and the counterparty agrees to pay Charlie Corp. a slightly lower fixed rate than what Charlie Corp. pays on its bond issue. Both payment streams have a notional amount of $10,000,000. The net effect is that Charlie Corp. has synthetically converted its fixed rate obligation under the bond issue to a floating rate obligation under the Swap.

IV. Synthetic Rates

When looking at the all-in effective rate of a floating rate loan that has been swapped to fixed rate, it is important not to lose sight of the components of same. For example, see *Figure 1,* and assume a five-year floating rate bank loan at LIBOR plus 1% that has been swapped to maturity. In *Figure 1*, the fixed rate on the Swap is 6.75% and it is swapped for one month LIBOR.

Figure 3. Borrower's Cashflow Summary: Floating to Fixed

Loan	(LIBOR +1%)
Swap	LIBOR
	(6.75%)
Effective Rate	(7.75%)

The Borrower's cashflows associated with both the loan and the Swap, (diagrammed in *Figure 1*) are illustrated in *Figure 3*. Outflows are represented as negative number(s) in parenthesis, and inflows as positive numbers. Note that the LIBOR payment on the loan is offset by the LIBOR payment received on the Swap. The effective rate for the loan after the Swap is the fixed rate on the Swap (6.75%) plus the spread, e.g., the margin on the original loan (1%). People commonly forget to account for the spread on the original loan when calculating the synthetic

all-in rate of the swapped loan. Swaps are almost always executed against LIBOR (or another index), without a margin, so the spread must be added back.

In Example 2, Charlie Corp. was able to issue fixed rate bonds to build its new widget factory. Lisa Likeable, the Charlie Corp. Treasurer, was pleased because she thought that interest rates would rise. However, with five years remaining in the bonds' term she saw rates falling and thought that they would continue to fall. Although American Bank, N.A. was willing to provide Charlie Corp. with a floating rate loan, the Charlie Corp. bond issue had some very substantial prepayment premiums. Therefore, after a call to the Cheryl Clinch Swap desk, Lisa Likeable decided to capitalize on her perception that rates were falling by executing the Swap transaction described in Example 2. The cash flow summary in *Figure 4* illustrates the cash flows for such a transaction.

Figure 4. Borrower's Cashflow Summary: Fixed to Floating

Bonds	(4.0%)
Swap – Fixed Rate	3.5%
Swap – Floating Rate	(LIBOR)
Effective Rate	(LIBOR +.5%)

By implementing this Swap transaction, Lisa Likeable converted a fixed rate of 4% on the bonds to a synthetic floating rate of LIBOR plus .5%.

V. Payment Netting[1]

Swap payments are usually netted against each other under the terms of the Swap agreement. For example, in the floating to fixed rate Swap diagrammed in *Figure 1* and discussed in Example 1, the fixed payment was 6.75%. If the LIBOR rate for the period was 5%, the Borrower's 6.75% payment would be reduced by the 5% LIBOR payment it received from the Swap counterparty. In addition, the Borrower would have paid its lender 6% (the 5% LIBOR rate plus 1%). The net result for the Borrower was a rate of 7.75% (6% to its lender and 1.75% to its Swap counterparty).

It should be remembered that the cash flow components are the result of the payments received and made to and from two different parties, the lender and the counterparty Swap provider. The mechanics of the Swap require that the fixed rate paid by the Borrower be netted against the

[1] The "netting" discussed in this article is the netting of the fixed and floating rate payment streams which should be distinguished from netting in bankruptcy situations under the ISDA Master Agreement.

LIBOR rate (without margin) received by the Borrower from the counterparty. Thus when the LIBOR rate rises the Borrower will receive relatively more money from the counterparty which will be offset by the correspondingly higher LIBOR rate paid by the Borrower on the loan. Similarly, if the LIBOR rate decreases, the payment received by the Borrower from the counterparty will be less, but Borrower's payment to the lender on the floating rate loan will be lower.

VI. Conclusion

Even plain vanilla interest rate Swaps can be complicated due to the multiple parties and payment streams. Diagramming the loan and Swap payments will aid in counseling Swap users in understanding the effective all-in synthetic rate on the Swap and the attendant netting process. Having "swap math" knowledge will prepare you for the inevitable phone call from Lisa Likeable, the Charlie Corp. Treasurer, asking why her payments to Cheryl Clinch have increased. You will calmly reply, "Yes, LIBOR has declined but that same decline means that Charlie Corp. is paying less on its floating rate loan to American Bank, N.A.".