CHAPTER 13
CURRENCY AND INTEREST RATE SWAPS

Chapter Overview

This chapter is about currency and interest rate swaps. It begins by describing the origins of the swap market and the role played by capital controls. The growth of the market and some description of the players is also discussed. The currency and interest rate swap market began in the early 1980s. By the mid-1990s, the notional principal value of swaps outstanding surpassed $20 billion. This figure adequately shows the tremendous growth of the market.

It then develops the basic pictures that describe the cash flows of simple interest rate and currency swaps. It uses these to examine the risks that are borne by the counterparties in a swap transaction. An important theme is how one should measure these risks. It outlines a simulation approach for measuring market risk and show that the time pattern of behavior in the floating interest rate is a key determinant of risk for interest rate swaps. With the building blocks in place, it outlines the determinants of swap prices. For interest rate swaps, the relationship between swap rates and interest rate futures contracts is examined.

The swap market has spawned numerous policy issues, especially as cases involving large losses incurred by corporations and financial portfolio managers have come to light. The chapter reviews the major policy issues that affect private enterprises in their use of the swap market. And in the final section, it considers those issues that are of primary concern to public policymakers in this new and fast growing financial market.

Chapter Outline

Origins and Underpinnings of the Swap Market
  The Role of Capital Controls
  Factors Favoring the Rise of Swaps
  Swaps Outstanding, the Volume of Transactions, and Gross Exposure

The Basic Cash Flows of a Swap Transaction
  Currency Swap
  Interest Rate Swap

Risks in Swaps
  Swap Risks for the Hedger
  Swap Risks for the Speculator
  Measuring the Risks of Swaps
  Using Simulation to Estimate the Risks of Swaps

The Pricing of Swaps
  Price Quoting Conventions in the Swap Market
  The Fundamental Determinants of Swap Prices
Policy Matters - Private Enterprises
  Applications of Swaps: Capturing Arbitrage Opportunities, Reducing Risks,
  Enhancing Sales
  Pricing Interest Rate Swaps: The Source of Gains
  Applications of Swaps: Magnifying Risk and Return
  Formation of AAA-Rated Subsidiaries
Policy Matters - Public Policymakers
  A Large-Scale Default Hits the Swap Market
  BIS Capital Requirements for Swap Transactions
  Netting Agreements and the Risk Exposure of Swap Transactions
Summary
Appendix 13.1: Valuing the Cash Flows in an Interest Rate Swap
**Supplementary Notes**

*Motives for swaps*

- Capital market segmentation
- Interest rate and exchange rate risk management
- Financial product development
- Asymmetric information

*Currency swap*

*Lone-term forward contracts*

FX forward contracts may not exist for less-traded currencies (market failure in certain currencies); forward contracts for widely traded currencies are fairly short (market failure for certain maturities).

*Straight currency swap*

The exchange of two currencies at the current exchange rate with an agreement to reverse the trade -- at the same exchange rate -- at some set date in the future. One of the parties will pay the other annual interest payments.

Example:

Company A has $1,000,000, and wishes to swap for 180,000,000 yen with Company B for a year. Interest rate is 15% for $; 10% for yen.

According to interest rate parity:

The $ is selling at forward discount of (or expected to depreciated by) 5%. So the $ is expected to be worth less a year from now. The party who is going to pay back in $ should pay a premium of approximately 5% ($50,000 = $1,000,000 x 5%).

The breakeven exchange rate:

180 yen/$ (1.10)/1.15 = 172.173913 yen/$

1,800,000,000 yen will be worth (1,800,000,000 / 172.173913) $1,045,454.55

So the party that gives up yen and gets $ now will get back the same amount of yen with more dollars.
It works like mutual lending: Company A lends $ to B and borrows yen from B for the amounts of equal value (through exchange rate) measured in any particular currency.

**Back-to-back and parallel loans**

Back-to-back loans are loans between two companies in different countries, each of which makes the other a loan in its respective currency.

Parallel loans involve two companies in different countries, each of which has a subsidiary in the other’s country. Each company makes a loan to the other company’s subsidiary.

**Swap of debt payments**

Each company issues fixed-rate debt in a currency that is available to it; then the two companies swap the proceeds of the debt issue and also assume each other’s obligation to make interest and principal payment.

IBM and World Bank: 1981 Salomon Brothers as intermediary

IBM had DM and Swiss franc loans in 1981 (borrowed in earlier years), pay interest in DM and SF

When $ appreciated in 1981, IBM enjoyed low payment in $

To capitalize this gain, get out these loan and interest payment

World Bank issued eurodollar bonds

IBM and World Bank swap debt payments: IBM pay $ for WB, WB pay DM and SF for IBM

**Interest Rate Swap**

One party issues fixed-rate debt while another issues floating-rate debt, and the two parties swap interest payment obligations based on a notional principal amount.

The term notional refers to the theoretical principal underlying the swap. Thus, the notional principal is simply a reference amount against which the interest is calculated. No principal ever changes hands.

**Example**

A bank wants floating-rate debt
A company wants fixed-rate debt
Bank can borrow at 11.5% fixed or at LIBOR
Company can borrow at 14% fixed or at 1% above LIBOR

Bank issues $50,000 of fixed-rate debt at 11.5%
Company issues $50,000 of floating-rate debt at 1% above LIBOR

Then swap interest payments:

Company pay 12% to bank, bank pay LIBOR to company

Cost to bank: LIBOR + (11.5% - 12%) = LIBOR - .5% < LIBOR
Cost to company: LIBOR + 1% - LIBOR + 12% = 13% < 14%

Each party gets what it wants at a lower cost.

Risk premium for the bank: company may default on interest payment

Cross currency interest rate swap

Floating-rate debt in one currency for fixed-rate debt in another currency.

Renault (French auto company) and Yamaichi (Japanese securities firm):

Renault wanted fixed-rate yen debt, but face regulatory barrier.

Arranged by Bankers Trust as follows:
Yamaichi borrowed floating-rate dollar debt, handed the proceeds to Renault but assumes interest payment and principal repayment obligation; Renault made interest and principal payment to Yamaichi.


Note: Numbers have been disguised.

Initial arrangements

1. Kodak issued bond of A$200,000,000 (Australian dollar) priced at 54 1/8 with 1 1/8 spread, get A$106,000,000 (Maturity: 5/12/92)
2. Give proceeds of A$106,000,000 to Merrill Lynch for $75,000,000 debt, with Merrill Lynch agreed to pay A$200,000,000 in 5 years
3. How does Merrill Lynch get $75,000,000? (ML now has A$106,000,000 from Kodak)
   1). Swap with Australian bank B:
      Bank B (borrows by) issues A$130,000,000 zero coupon bond to ML at semiannual rate of 13.39%, ML pay A$68,000,000;
      Bank B lends the equivalent of the proceeds to ML in $: $48,000,000
   2). ML sells A$38 million (A$ 106 - A$68) to Bank A at current price, get $27,000,000
   Total payment A$106 million (received from Kodak), pay $75 million to Kodak

4. Interest payments:
   ML buys A$70 million forward (long-dated) with Bank A at $.5286/A$ (pay $37 million in total)

5. Kodak pay fixed interest to ML for the $75 million at 7.35% /2 semiannually

6. ML makes floating-rate payment to B; swap to hedge interest rate risk

Settlements in five years:

7. Bond of B due, B pays ML A$ 130 million
   ML fulfill forward contract with A, get A$70 million
   ===> ML now has A$200 million to pay off Kodak’s debt (bond)

8. ML pays off its debt ($48 million) to B
   Kodak pays off its debt to ML $75 million

Benefit to ML: Service fees and other cash flows.
Benefit to Kodak: lower rate (7.35% compared to 7.5%, saving 15 bp)

**Interest Rate and Currency Swaps -- An Exercise**

Suppose Company A wants 5-year fixed rate dollar funding while Company B wants 5-year fixed rate Japanese yen funding. Company A’s direct borrowing all-in-cost is 9.50% in dollars and 7% in Japanese yen. Company B’s direct borrowing all-in-cost is 8.25% in dollars and 8% in Japanese yen.

a. Refer to the quotes by a bank on the next page and design a swap between the two companies involving the bank. Show, by means of diagrams, the initial, annual and final cash flows arising from the swap. Make sure the diagram shows the yen rates the bank receives and pays, and the dollar rates the bank receives and pays.

b. What is the maximum gain for all parties involved through this swap? What is the effective borrowing cost for each company? How much does each company save through the swap? How and explain.
Currency swaps

<table>
<thead>
<tr>
<th>Term</th>
<th>Yen Bid</th>
<th>Yen Offer</th>
<th>U.S. dollar Term</th>
<th>U.S. dollar Bid</th>
<th>U.S. dollar Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
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<td>7.22</td>
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<td>6.89</td>
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<td>7</td>
<td>8.55</td>
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<tr>
<td>10</td>
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<td>6.86</td>
<td>10</td>
<td>8.68</td>
<td>8.72</td>
</tr>
</tbody>
</table>

Note: For all the swap quotes above, the bid rate is the fixed rate the bank pays to the fixed rate receiver, and the offer rate is the fixed rate that the bank receives from the fixed-rate payer. All of the above interest rate swap quotes are fixed rates against the six-month LIBOR rate in the same currency. The currency swap quotes are fixed rates in the currency concerned against six-month U.S. dollar LIBOR.

Suggested answer:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>9.50%</td>
<td>8.25%</td>
</tr>
<tr>
<td>¥</td>
<td>7.00%</td>
<td>8.00%</td>
</tr>
</tbody>
</table>

2.25% Max gain

A has comparative advantage in ¥ borrowing;
B has comparative advantage in $ borrowing;

A desires $ funding;
B desires ¥ funding;

Effective costs and savings:

A:  
- Pays to bank: -8.39%
- Pays to ¥ debt: -7.00%
- Receives from bank: 7.12% => -8.27%

Direct borrowing cost: 9.50%
Effective cost: 8.27% => Saving: 1.23%
B: Pays to bank -7.17%
   Pays to $ debt -8.25%
   Receives from bank 8.35% => -7.07%

   Direct borrowing cost 8.00%
   Effective cost 7.07% => Savings: 0.93%

The Bank benefits from swap:

$ spread: 8.39% - 8.35% = .04%
¥ spread: 7.17% - 7.12% = .05% => Total .09%

1.23% + .93% + .09% = 2.25% maximum gain for all parties
Answers to end-of-chapter questions

1. Describe the advantages of a swap agreement over a back-to-back loan?

   Back-to-back loans are more time consuming to arrange than swaps. A back-to-back loan results in two legally separate loans while a swap could embody the right-of-offset in the event that one counterparty defaults. Finally, back-to-back loans are on-balance-sheet transactions. In their early years, and still under some circumstances, swaps are considered off-balance-sheet.

2. How can a swap be used to circumvent capital controls on financial market transactions?

   A swap can circumvent a capital control by taking the financial transaction outside of the domain of a regulatory body. A control on borrowing DM can be circumvented by borrowing US$ and entering into a US$-DM currency swap.

3. Describe a fixed-floating interest rate swap in terms of forward (futures) contracts. Explain the advantages of a swap agreement compared to forward contracts.

   In a fixed-floating interest rate swap, one counterparty agrees to receive a fixed rate and pay a floating rate at regular intervals over a period of years. The swap represents a set of forward contracts, with maturities 6 months, 12 months, 18 months, etc. The cash flows of a swap contract could be replicated with a set of interest rate futures contracts. Combining all of these transactions into a single swap agreement lowers transaction costs, makes the responsibilities of counterparties explicit, and extends the maturity of the market beyond the normal maturity of interest rate futures contracts.

4. “A fixed-rate payer in a fixed-floating interest rate swap can be viewed as short the bond market.” True or false? Explain.

   True. A fixed-rate payer receives floating-rate interest. If interest rates increase (and bond prices fall), the fixed-rate payer earns a profit from his higher income stream. A speculator with a short position in the bond market also profits when interest rates increase.

5. “A floating-rate payer in a fixed-floating interest rate swap can be viewed as short the bond market.” True or false? Explain.

   False. A floating-rate payer receives fixed-rate interest. If interest rates increase (and bond prices fall), the floating-rate payer feels a loss from his higher interest expenses. A speculator with a long position in the bond market also suffers a loss when interest rates increase.
6. What are the differences, in terms of required cash flows, between an interest rate swap and a currency swap? Describe both.

In an interest rate swap, each counterparty pays interest to the other on an agreed notional amount of currency. Typically, one counterparty pays fixed and the second counterparty pays a floating rate, where the floating rate could be LIBOR, PRIME, 5-year US Treasury, Federal Funds rate, etc. A floating-floating interest rate swap is also possible where each counterparty pays interest to the other on the basis of a different floating rate schedule. The primary difference in a currency swap is that there is an initial exchange of notional principal values (one currency for another at the initial spot exchange rate) and a final exchange of principal that reverses the initial exchange.

7. Explain how firms can take advantage of comparative and absolute advantages in different credit markets using currency swap agreements?

A firm can take advantage of its comparative advantage by borrowing in the capital market in which it borrows at a low rate relative to other firms who borrow in the same capital market. The firm can then arrange a swap to effectively re-denominate the currency of denomination of its debt liabilities.

8. Describe a cross-currency interest rate swap in terms of interest rate swaps and currency swaps.

A cross-currency interest rate swap changes both the currency of denomination of a liability (or asset) and the interest rate basis (whether fixed or floating) of the liability (or asset). The cross-currency interest rate swap. A cross-currency interest rate swap may be visualized as an ordinary fixed-floating interest rate swap combined with a fixed-fixed (or floating-floating) currency swap.


A swap dealer plays a role similar to that of a foreign exchange or government bond dealer. The swap dealer is usually an employee of a bank, securities company or other financial institution (or a subsidiary of one of these companies) The swap dealer is a counterparty to swap transactions with retail customers, and plays an intermediary role between retail customers. The swap dealer also trades on an interbank basis with other swap dealers. Interbank trading helps to establish market liquidity and market prices for various categories of swaps.

10. What is counterparty risk in a swap agreement? What is market risk in a swap agreement? What is the right-of-offset in a swap agreement?

Counterparty risk encompasses the risk of default by one of the counterparties to a swap transaction. Market risk in a swap is the risk that the replacement cost of a swap, once a
counterparty has defaulted, will be higher than its initial cost. The right-of-offset refers to
the responsibilities of one counterparty to a swap once the other counterparty has
defaulted. The right-of-offset implies that the non-defaulting counterparty is relieved
from continuing to make payments as in the original swap agreement.

11. Define “Master Swap Agreement.” Why is a Master Swap Agreement important for swap
dealers?

A Master Swap Agreement is a legal contract between one counterparty, usually a bank,
and a second counterparty, usually the bank’s customer that is designed to incorporate all
swaps between the two counterparties. The MSA, in effect, consolidates all of the swaps
between the two counterparties in a single “master swap.” In case of a customer default,
the liability of the bank is limited to the net exposure of the master swap. With a master
swap, the customer loses the opportunity for cherry-picking whereby he defaults on out-
of-the-money swaps but demands payment on in-the-money swaps.

12. Describe the simulation approach to measuring the risk of swaps. What is the main
drawback of the method?

Consider an interest rate swap where the risk is the uncertain path of the floating rate over
the life of the swap. The simulation method constructs a hypothetical path for the floating
rate using an estimate of the interest rate’s volatility ($\sigma$). The study by Simons (1989)
assumed that the market interest rate ($i_t$) evolves so that $i_t = i_{t-1} e^x$ where $x$ is normally
distributed with mean zero and standard deviation $\sigma$. At each point in time ($t$), we can
calculate how much the value of the swap had changed and how much the bank would
have lost from a default. By repeated simulation of other hypothetical paths, we can
calculate an average or expected value of exposure over the life of the swap.

13. Describe the diffusion effect and the amortization effect in swaps.

The diffusion effect is the pattern of risk associated with the time pattern of financial
prices and their tendency to take on wider, more dispersed, values over time. The
diffusion effect implies greater risk as a swap matures. The amortization effect is the
pattern of risk associated with the decline in the number of cash exchanges between
counterparties as a swap matures. The amortization implies reduced risk as a swap
matures.

14. What is the best way to price a swap?

Swaps are priced using the net present value rule. The fixed rate side (payer or recipient)
knows the cash flows expected over time. The floating rate side can estimate the expected
cash flows from the term structure of forward interest rates or interest rate futures
contracts. A par swap sets the net present value of the cash flows, paid and received,
equal to zero and determines the pricing of the fixed rate side.
15. What does it mean for a firm to mark its portfolio of swaps to market?

A swap is mark-to-market by calculating the net present value of all expected cash flows paid or received in the swap. The fixed side is specified in the swap agreement and the floating side can be estimated from the term structure of forward interest rates or interest rate futures contracts.


A swap is in-the-money if the expected net present value of cash receipts minus cash payments is positive. The owner of an in-the-money swap must be paid to terminate the swap. A swap is out-of-the-money if the expected net present value of cash receipts minus cash payments is negative. The owner of an out-of-the-money swap must pay money to terminate the swap.

17. Describe the swap contracts and the circumstances that led to the default by British municipal councils in the late 1980s.

The British municipal councils entered into interest rates swaps whereby they received fixed rate interest and paid floating rate interest. As short-term interest rates rose, these swaps became substantially out-of-the-money, as cash outflows exceeded cash inflows.

18. How can a firm or a financial institution transform its capital structure by using swaps?

A firm’s capital structure represents the currency and interest rate basis of its assets and liabilities. A firm with liabilities in currency X can enter a swap to receive currency X and pay currency Y. This effectively transforms their liability into a currency Y liability. Similarly with assets, if the firm holds assets that receive fixed rate interest, it can enter into a swap to pay fixed rate interest and receive floating rate interest. This effectively transforms their assets into a floating rate form.

19. Suppose that a bank earns 10% semi-annual on a 5-year loan and that the bank finances itself with 6-month LIBOR. How could a 5-year swap agreement in which the bank pays a fixed rate and receives a floating rate be of benefit?

The bank would enter into a swap to pay a fixed interest rate and receive a floating 6-month LIBOR rate. The bank’s asset (the 10% loan) is used to pay the fixed side of the swap. The receipt of floating rate interest is used to pay off its floating rate finance. The swap could benefit the bank by reducing its exposure to interest rate risk.

20. Who are the main players in the swap market? What is the rationale behind the creation of AAA-subsidiaries by large banks to handle swap transactions?
The main swap players are dealers, who are usually at large commercial banks, investment banks or securities firms, and end-users who are also banks, other financial institutions, and large industrial firms. Subsidiaries with separate capitalization and AAA credit ratings have been set up to reduce concerns over counterparty default. Pricing of swaps and the ability of a dealer to conduct business is enhanced if default risk is minimized.

21. In 1994, Procter and Gamble lost $157 million in a swap transactions with Bankers Trust. On Page 474, we showed the formula for the rate of interest for payments by P&G under the swap agreement. What was the rationale behind the deal for P&G? for Bankers Trust? Under what circumstances would P&G gain (lose) from the transaction?

The motivations behind the Bankers Trust - P&G deal are uncertain. We can surmise that the transaction was speculative from P&G’s side; in other words, a bet that interest rates would fall and make the swap profitable for them. From Bankers Trust side, the deal may not have been speculative if they hedged their position with other swaps written with other counterparties. Bankers Trust may have hoped to earn fees from the deal and hedge itself no matter what the future path of interest rates.

**Answers to end-of-chapter exercises**

1. Suppose Firm ABC can issue 7-year bonds in the US at the fixed rate of 8% and in France at 13%. Suppose Firm XYZ can issue 7-year bonds at the fixed rate of 10% in the US in US$ and at 14% in France in FFr.
   a. Which firm has a comparative advantage in the French capital market?
   b. How would you advise both firms so that they take advantage of each other’s comparative advantage in the US and French capital markets?
   c. How much could be saved in borrowing costs by both firms?
   d. What could cause the relative comparative advantages in international credit markets?

**SOLUTIONS:**
2. Suppose two parties enter a 5-year interest rate swap to exchange one-year LIBOR plus 50 basis points (bp) for a fixed rate on $100 million notional principal.

   a. If LIBOR turns out to be 10% in year 1, 9% in year 2, 9% in year 3, 8% in year 4 and 8.5% in year 5, what cash flows will be exchanged between the two parties? Assume a flat Eurodollar yield curve at 10%.
   
   b. What is the value of the swap?
   
   c. What fixed rate in the swap agreement will make the value of the swap equal to zero?

SOLUTIONS:
3. Estimate the current value of the following 5-year swap agreement:

Pay fixed rate of 5%
Receive fixed rate of 10%

Assume a flat yield curve at 7%.

SOLUTIONS:

The swap price is determined by using the Net Present Value of the future cash-flows associated with the swap. Cash flows are known with certainty because both sides of the swap have fixed their interest rate obligations.

\[ NPV = \sum_{t=1}^{5} \frac{5}{(1 + 0.07)^t} \]

So, NPV = $20.5

4. Suppose the one-year LIBOR is forecast to fluctuate as follows:

Year 1: 5.0%
Year 2: 5.5%
Year 3: 6.0%
Year 4: 7.0%
Year 5: 7.5%

Determine the swap quote a dealer would post on fixed-floating 5-year $100-million interest rate swap. Suppose the floating index is the one-year LIBOR, and the 5-year Treasury rate is 6%.

SOLUTIONS:

Valuation of a five year swap.

<table>
<thead>
<tr>
<th>Period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Receive</td>
<td>5%</td>
<td>5.5%</td>
<td>6%</td>
<td>7%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Cash-Flows</td>
<td>$5</td>
<td>$5.5</td>
<td>$6</td>
<td>$7</td>
<td>$7.5</td>
</tr>
<tr>
<td>Pay Fixed</td>
<td>x%</td>
<td>x%</td>
<td>x%</td>
<td>x%</td>
<td>x%</td>
</tr>
</tbody>
</table>
We use the NPV formula to determine \( x \). NPV must equal zero. The fixed rate is determined as 6.11%. If the 5-year Treasury rate is currently traded at 6%, the swap quote will be +11 b.p.

5. Suppose the US yield curve is flat at 7% and the French yield curve is flat at 12%. The current US$/FFr exchange rate is FFr 5.25/$. 

   a. What will be the swap rate on an agreement to exchange every year $1 million for French Francs over the next 5 years?

   b. Suppose that the counterparty paying US$ defaults in year 3. The US$ has depreciated to FFr 5/$. What is the net result for the FFr paying counterparty? How much will the firm lose (gain) when it negotiates a new swap contract for the remaining 2 years?

6. Following is the 7-year swap agreement entered by the World Bank and IBM in 1981:

   The World Bank borrowed at US Treasury plus 40 b.p., received US Treasury plus 40 b.p. from IBM, and paid Swiss Treasury plus 10 b.p. to IBM.


   The current SFr/US$ rate was SFr 1.50/US$. The World Bank exchanged with IBM $100 million for SFr 150 million.

   a. How would you define this swap? What are the risk for both counterparties?

   b. What is the total costs and savings for each party?

   c. Suppose the World Bank defaults in year 2 of the agreement. US interest rates went up from 9% to 12% and SFr interest rates fell from 5% to 4.5%. The exchange rate is now SFr 1.35/$. Design a new swap agreement that would restore IBM’s position. What is the magnitude of the loss incurred by IBM?

**SOLUTIONS:**

   a. This could be described as a fixed-rate currency swap. It is a currency swap because the two counterparties are swapping US$ and SFr, and it is a fixed-rate swap because the interest rate that each counterparty pays is fixed on the initial date of the swap \( (t_0) \).
The risks to each counterparty are the risk of a price change in one of the financial prices ($i_{US}$, $i_{SF}$, or the spot SFr/US$ exchange rate) in the event that the other counterparty should default on the swap.

For example, if the World Bank defaults on this swap, IBM must find a new counterparty. Under the original swap, IBM is obligated to:

- Pay US$ interest at the initial US Treasury rate +40 bp
- Receive SFr interest at the initial Swiss Treasury rate + 10 bp
- Return US$ to the World Bank in exchange for SFR at the initial spot exchange rate.

IBM will be worse off (and is therefore exposed to risk) if $i_{US}$ rises, $i_{SF}$ falls, or the US$ depreciates (SFr/US$ falls).

The situation is similar (but reversed) for the World Bank. They will be worse off (and therefore exposed to risk) if $i_{US}$ falls, $i_{SF}$ rises, or the US$ appreciates (SFr/US$ rises).

**NOTE WELL:** If both counterparties follow through on all their stipulated cash flows in the swap, there is no risk (no surprises) to either counterparty. The risks we are describing are the risks of a default coupled with an adverse price movement.

b. The total costs include:

<table>
<thead>
<tr>
<th></th>
<th>Costs to World Bank</th>
<th>Costs to IBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest cost on US$ 100 million</td>
<td>Zero: World Bank pays and receives UST + 40bp</td>
<td>UST + 40bp</td>
</tr>
<tr>
<td>Interest cost on SFr 150 million</td>
<td>Swiss Treasury + 10 bp</td>
<td>Minus 10 bp: IBM receives Swiss Tr + 10 bp and pays out only Swiss Tr</td>
</tr>
<tr>
<td>Swap underwriting costs and fees</td>
<td>Not disclosed</td>
<td>Not disclosed</td>
</tr>
</tbody>
</table>

We cannot determine the US$ or SFr amount of interest costs unless we know the original level of interest rates.
We can only say that the World Bank paid Swiss Treasury + 10 basis points, and saved 10 bp; while IBM paid US Treasury +30 basis points, and saved 15 bp.

c. A default by the World Bank in year 2 means that IBM will incur a loss equivalent to the replacement cost of the remaining cash flows of the swap. While we cannot calculate the amount of the loss precisely, the components of the loss include the following:

- IBM will pay 300 bp more on $100 million of debt for 5 years
- IBM will receive 50 bp less on SFr 150 million for 5 years
- IBM holds $100 million that it received in year t0 and planned to exchange for SFr 150 million in year t7. At the present exchange rate (1.35 SFr/US$), IBM will need about $111.11 million to exchange for SFr 150 million needed to retire their bonds.

The present value of these flows represents the loss to IBM from the default. In addition, there may be further costs or fees to arrange the replacement swap.

7. Suppose the 7-year Treasury yields 8%. What will be the bid and offer quote proposed by a dealer in the following fixed-floating 7-year swap:

Fixed-rate payer pays fixed rate of 8.5% and receives 6-month LIBOR;
Floating-rate payer pays 6-month LIBOR and receives fixed rate 8.25%.

a. What is the bid-offer spread?

SOLUTIONS:

The swap quote is determined by the difference between the Treasury yield for maturities equal to that of the swap and the fixed rate in the swap agreement.

Here, the fixed rate payer pays 8.5% fixed, resulting in an offer quote of 50 b.p. The floating rate payer will receive 8.25% fixed, resulting in a bid quote of 25 b.p.


8. Suppose a bank has a portfolio of fixed rate 7-year mortgages. The total principal amount is $100 million and interest rate is 10%. Interest is paid semi-annually and principal is scheduled to be repaid at maturity. The bank finances its loan portfolio with six-month CDs at an interest rate equal to six-month LIBOR plus 25 basis points. The current interest rate on futures contracts is 9%.
a. Describe the interest exposure of the bank, supposing no prepayment during the length of the loans. At what point does the bank begin to lose money on its borrowing/financing position?

b. Suppose a 7-year fixed-floating interest rate swap is available with a notional amount of $100-million for the following terms:
   - pay fixed 9% every six months
   - receive 6-month LIBOR

   How can the bank use this swap to hedge its interest rate exposure?

c. Calculate the spread the bank would lock in if it choose to enter the swap agreement?

d. Suppose in year two that 20% of the mortgages are prepaid. What is the position of the bank regarding its interest rate exposure? How can it adjust its swap position?

e. What risk does the bank face if it has to reverse part of its swap position? What is the market value of the loss (gain) incurred by the bank when it reverses part of the swap if the yield curve is flat at 10%?

SOLUTIONS:

a. The bank receives a fixed rate from its mortgage portfolio. Its cash-flow pattern is as follows: 10% - (LIBOR + 0.25%). The bank is exposed to increases in short-term rates, specifically in 6-month LIBOR.

   If its revenues from its fixed-rate mortgages do not cover its obligations on CDs, the bank will lose money on its position. Its obligations are yielding LIBOR + .25%. Therefore, whenever LIBOR is more than 9.75%, the company’s interest income will not cover its obligations and the firm will lose money.

b. If the firm enters into the available swap, it will hedge its asset/liability exposure.

   Money received: From Mortgages 10%
   From Swap Agreement LIBOR
   Net Received LIBOR + 10%

   Money Paid: To CD-holder LIBOR + .25%
   Thru Swap Agreement 9%
   Net Paid 9.25% + LIBOR

c. Spread Income: (LIBOR + 10%) - (LIBOR + 9.25%) = 0.5%

   Using a swap, the firm is able to lock in a spread income and hedge itself.
d. Now that repayment has occurred on 20% ($20 million) of mortgages, the bank receives 10% interest on $80 million of outstanding mortgages, while the notional amount of its swap and CDs outstanding remain at $100 million. This gives the bank a liability exposure. The bank pays 9.25% + LIBOR on $100 million, and receives 10% on $80 million, and receives LIBOR on $100 million.

The bank needs to make two transactions to offset the impact of the early repayment: (1) Reduce the size of its 6-month CD portfolio by $20 million; (2) Enter into a new 5-year swap paying LIBOR and receiving fixed rate interest for a $20 million notional amount. The second transaction effectively reduces the size of the bank’s original swap to $80 million.

e. The bank faces the risk that the terms on the second swap will be less favorable, in particular, that it will receive a lower fixed interest rate on the second swap than it found itself paying on the first swap (which was 9.50%). If the fixed rate leg on the second swap is only 9.00%, then the bank will lose 0.50% on $20 million, per annum for 5 years. The present value of this cash flow at a 10% discount rate is $379,079.

Note how the risk of repayment works against the bank here. When interest rates fall, the incentive increases for borrowers to speed up refinancing their mortgages. The greater the fall in rates, the greater the incentive to refinance, and the greater the loss to a bank on its reversing swap. This suggests that a bank would not want to swap an entire pool of mortgages (because there will be some early repayments), but figuring out how much to swap involves many uncertainties.

9. Suppose a life insurance company issued $100 million of five-year Guaranteed Investment Contracts that commit it to pay a fixed rate of 9% semi-annually. Suppose the company is able to invest $100 million in a five-year semi-annual floating rate instrument yielding 6-month UBOR plus 100 b.p.

a. Describe the interest exposure by the insurance company. At what point would the company not be able to earn enough on the floating rate instrument to pay for its fixed obligations?

b. Suppose there is available in the market a 5-year fixed-floating interest rate swap with a notional amount of $ 100-million with the following terms:
   - receive fixed 8.5% every six months
   - pay 6-month LIBOR

How can the insurance company use this swap to hedge its interest rate exposure?
c. Calculate the spread the company would lock in if it choose to enter the swap agreement.

**SOLUTIONS:**

a. The company is obligated to pay 9% fixed. Its cash-flow pattern is as follows: LIBOR + 1% - 9%. Company is exposed to decreases in short-term interest rates.

If its revenues from its floating-rate investment is less than 9%, the firm will lose money on its positions. Its investment is yielding LIBOR + 1%. Therefore, whenever LIBOR is less than 8%, the company’s interest income will not cover its obligations and the firm will lose money.

b. If the firm enters into the available swap, it will hedge its asset/liability exposure.

Money received:  
- From Original Investment: LIBOR + 1%
- From Swap Agreement: 8.5%
- Net Received: LIBOR + 9.5%

Money Paid:  
- To GIC: 9%
- From Swap Agreement: LIBOR
- Net Paid: 9% + LIBOR

d. Spread Income:  
\[(\text{LIBOR} + 9.5\%) - (\text{LIBOR} + 9\%) = 0.5\%\]

Using a swap, the firm is able to lock in a spread income and hedge itself.

10. Consider the following tables showing the swap transactions between the ABC Bank and XYZ, Inc. Suppose that XYZ files for bankruptcy and the firm defaults on its swap agreements with ABC Bank.

a. Calculate the potential loss of ABC Bank assuming that its swaps with XYZ are not in a Master Swap Agreement.

b. Calculate the potential loss of ABC Bank assuming that its swaps with XYZ are all part of a single Master Swap Agreement.
### SUMMARY OF TRANSACTIONS WITH COUNTERPART XYZ, as of 12/31/97

<table>
<thead>
<tr>
<th>Date of Swap</th>
<th>Currency</th>
<th>Maturity</th>
<th>Notional Amount</th>
<th>Contract Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/1/96</td>
<td>DM</td>
<td>5 years</td>
<td>20,000,000</td>
<td>Receive Fix / Pay LIBOR</td>
<td>$25,000</td>
</tr>
<tr>
<td>3/15/97</td>
<td>UK£</td>
<td>7 years</td>
<td>10,000,000</td>
<td>Receive Fix / Pay LIBOR</td>
<td>$15,000</td>
</tr>
<tr>
<td>6/1/97</td>
<td>US$</td>
<td>3 years</td>
<td>10,000,000</td>
<td>Receive LIBOR / Pay Fix</td>
<td>-$60,000</td>
</tr>
<tr>
<td>8/31/97</td>
<td>US$</td>
<td>7 years</td>
<td>5,000,000</td>
<td>Receive C.P. / Pay Fix</td>
<td>-$30,000</td>
</tr>
</tbody>
</table>

**SOLUTIONS:**

a. If the swaps are not in a Master Swap Agreement, ABC Bank could lose $40,000 (=25,000 + 15,000). These two swaps have positive value (NPV) for the bank, and after a default by XYZ, Inc. the bank would not obtain this value. At the same time, ABC Bank would have to fulfill its obligations on the other two swaps with XYZ, which as of 12/31/97 have the bank paying out $90,000 in value to XYZ. This outflow is not an incremental loss to the Bank because of the default.

b. If the swaps are within a Master Swap Agreement, the maximum potential loss is the arithmetic sum of the value of the swaps. In the case, the sum is negative, -$50,000. This represents a loss to ABC Bank from entering into 4 swap agreements with XYZ that happen to have resulted in a loss to the Bank. However, there is no incremental loss to the Bank because of the default.
11. Examine the following table of interest rate swap price quotations published in the *Financial Times* of June 20, 2000.

<table>
<thead>
<tr>
<th>Interest Rate Swaps</th>
<th>Euro-E</th>
<th>£ Stlg</th>
<th>SwFr</th>
<th>US $</th>
<th>Yen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun 20</td>
<td>Bid</td>
<td>Ask</td>
<td>Bid</td>
<td>Ask</td>
<td>Bid</td>
</tr>
<tr>
<td>1 year</td>
<td>4.98</td>
<td>5.02</td>
<td>6.50</td>
<td>6.53</td>
<td>3.95</td>
</tr>
<tr>
<td>2 year</td>
<td>5.20</td>
<td>5.24</td>
<td>6.50</td>
<td>6.54</td>
<td>4.13</td>
</tr>
<tr>
<td>3 year</td>
<td>5.30</td>
<td>5.34</td>
<td>6.54</td>
<td>6.58</td>
<td>4.21</td>
</tr>
<tr>
<td>4 year</td>
<td>5.39</td>
<td>5.43</td>
<td>6.50</td>
<td>6.55</td>
<td>4.26</td>
</tr>
<tr>
<td>5 year</td>
<td>5.47</td>
<td>5.51</td>
<td>6.48</td>
<td>6.53</td>
<td>4.30</td>
</tr>
<tr>
<td>6 year</td>
<td>5.54</td>
<td>5.58</td>
<td>6.46</td>
<td>6.51</td>
<td>4.35</td>
</tr>
<tr>
<td>7 year</td>
<td>5.61</td>
<td>5.65</td>
<td>6.44</td>
<td>6.49</td>
<td>4.40</td>
</tr>
<tr>
<td>8 year</td>
<td>5.66</td>
<td>5.70</td>
<td>6.41</td>
<td>6.46</td>
<td>4.45</td>
</tr>
<tr>
<td>9 year</td>
<td>5.71</td>
<td>5.75</td>
<td>6.40</td>
<td>6.45</td>
<td>4.50</td>
</tr>
<tr>
<td>10 year</td>
<td>5.74</td>
<td>5.78</td>
<td>6.39</td>
<td>6.44</td>
<td>4.54</td>
</tr>
<tr>
<td>12 year</td>
<td>5.81</td>
<td>5.85</td>
<td>6.35</td>
<td>6.42</td>
<td>4.60</td>
</tr>
<tr>
<td>15 year</td>
<td>5.90</td>
<td>5.94</td>
<td>6.27</td>
<td>6.36</td>
<td>4.67</td>
</tr>
<tr>
<td>20 year</td>
<td>5.95</td>
<td>5.99</td>
<td>6.11</td>
<td>6.24</td>
<td>4.73</td>
</tr>
<tr>
<td>25 year</td>
<td>5.96</td>
<td>6.00</td>
<td>6.00</td>
<td>6.13</td>
<td>4.75</td>
</tr>
<tr>
<td>30 year</td>
<td>5.95</td>
<td>5.99</td>
<td>5.93</td>
<td>6.06</td>
<td>4.76</td>
</tr>
</tbody>
</table>

Bid and ask rates as of close of London business. US$ is quoted annual money actual/360 basis against 3 months LLBOR, £ and Yen quoted on a semi-annual actual/365 basis against 6 months LIBOR, Euro/Swiss Franc quoted on annual bond 30/360 basis against 6 month EUR1BOR/LIBOR with the exception of the 1-year rate, which is quoted against 3-month EURIBOR/LIBOR.


a. Make some general observations about the spreads that you see in the table. Do these patterns seem logical?

b. Suppose Firm A had issued a 7-year floating rate US$ bond at LIBOR+0 and wanted to swap it into fixed-rate terms. According to the information in the table, what fixed rate would Firm A wind up paying after entering into the swap?

c. Suppose Firm B had issued a 5-year fixed rate £ bond and wanted to swap it into floating-rate terms. According to the information in the table, what fixed rate would Firm B receive from their bank swap counterparty?
SOLUTIONS:

a.  

| Currency  | 20-Jun | 1 year | 2 year | 3 year | 4 year | 5 year | 6 year | 7 year | 8 year | 9 year | 10 year | 11 year | 12 year | 13 year | 14 year | 15 year | 16 year | 17 year | 18 year | 19 year | 20 year | 21 year | 22 year | 23 year | 24 year | 25 year | 26 year | 27 year | 28 year | 29 year | 30 year |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Bid       | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread | Bid    | Ask    | Spread |
| Euro-E    | 4.98   | 0.04   | 5.20   | 0.04   | 5.30   | 0.04   | 5.39   | 0.04   | 5.47   | 0.04   | 5.54   | 0.04   | 5.61   | 0.04   | 5.66   | 0.04   | 5.71   | 0.04   | 5.74   | 0.04   | 5.81   | 0.04   | 5.90   | 0.04   | 5.95   | 0.04   | 5.93   | 0.04   | 5.95   | 0.04   |
| £ Stg     | 6.50   | 0.03   | 6.50   | 0.04   | 6.46   | 0.05   | 6.35   | 0.05   | 6.27   | 0.09   | 6.11   | 0.13   | 6.00   | 0.04   | 5.93   | 0.13   | 4.76   | 0.10   | 4.73   | 0.10   | 4.75   | 0.10   | 4.67   | 0.10   | 4.60   | 0.07   | 5.00   | 0.13   |
| SwFr      | 3.95   | 0.03   | 4.13   | 0.04   | 4.35   | 0.05   | 4.70   | 0.07   | 4.67   | 0.09   | 4.73   | 0.13   | 4.85   | 0.10   | 4.62   | 0.13   | 4.86   | 0.10   | 4.77   | 0.10   | 4.75   | 0.10   | 4.70   | 0.07   | 4.83   | 0.10   | 4.85   | 0.10   |
| US$       | 7.16   | 0.03   | 7.22   | 0.04   | 7.24   | 0.05   | 7.25   | 0.06   | 7.25   | 0.07   | 7.25   | 0.08   | 7.26   | 0.09   | 7.26   | 0.08   | 7.26   | 0.08   | 7.26   | 0.09   | 7.26   | 0.07   | 7.26   | 0.06   | 7.28   | 0.09   | 7.28   | 0.08   |
| Yen       | 3.00   | 0.03   | 0.53   | 0.03   | 1.19   | 0.03   | 1.39   | 0.03   | 1.57   | 0.03   | 1.71   | 0.03   | 1.83   | 0.03   | 1.93   | 0.03   | 2.10   | 0.03   | 2.28   | 0.03   | 2.41   | 0.03   | 2.42   | 0.03   | 2.28   | 0.03   | 2.39   | 0.03   |

In general, it makes sense since the spread is increasing with the number of years. It reflects the fact that uncertainty increases over a longer period of time and hence a higher premium will be asked. However, a closer look reveals the unusual jump of the spread of Swiss Franc from 0.03 to 0.08 from the one-year period to the two-year period. Maybe this reflects the projected uncertainty of the magnitude of increase in the Swiss Franc nominal interest rate.

b. Synthetic fixed rate = (LIBOR + 0%) - LIBOR + 7.26% = 7.26%

c. 6.48%