ΑΣΚΗΣΕΙΣ – Κεφάλαιο 2, Ενότητα b

(Αντιστάθμιση Κινδύνου Επιτοκίου με Παράγωγα)

- **22.4, 22.6, 22.9, 22.12, 22.16, 22.19, 22.20, 22.21, 22.22, 22.23, 22.25**
- **24.4, 24.6, 24.7, 24.8**

22.4 *An FI holds a 15-year, $10 million par value bond that is priced at 104 with a yield to maturity of 7 percent. The bond has a duration of eight years, and the FI plans to sell it after two months. The FI's market analyst predicts that interest rates will be 8 percent at the time of the desired sale. Because most other analysts are predicting no change in rates, two-month forward contracts for 15-year bonds are available at 104. The FI would like to hedge against the expected change in interest rates with an appropriate position in a forward contract. What will this position be? Show that if rates rise 1 percent as forecast, the hedge will protect the FI from loss.*

ANSWER: The expected change in the spot position is –8 x $10,400,000 x (0.01/1.07) = -$777,570. This would mean a price change from 104 to 96.2243 per $100 face value of bonds. By entering into a two-month forward contract to sell $10,000,000 of 15-year bonds at 104, the FI will have hedged its spot position. If rates rise by 1 percent, and the bond value falls by $777,570, the FI can close out its forward position by receiving 104 for bonds that are now worth 96.2243 per $100 face value. The profit on the forward position will offset the loss in the spot market.

The actual transaction to close the forward contract may involve buying the bonds in the market at 96.2243 and selling the bonds to the counterparty at 104 under the terms of the forward contract. Note that if a futures contract were used, closing the hedge position would involve buying a futures contract through the exchange with the same maturity date and dollar amount as the initial opening hedge contract.

22.6. *Suppose an FI purchases a Treasury bond futures contract at 95.*

a. *What is the FI's obligation at the time the futures contract is purchased?*

ANSWER: The FI is obligated to take delivery of a $100,000 face value 20-year Treasury bond at a price of $95,000 at some predetermined later date.

b. *If an FI purchases this contract, in what kind of hedge is it engaged?*

ANSWER: This is a long hedge undertaken to protect the FI from falling interest rates.

c. *Assume that the Treasury bond futures price falls to 94. What is the loss or gain?*

ANSWER: The FI will lose $1,000 since the FI must pay $95,000 for bonds that have a market value of only $94,000.

d. *Assume that the Treasury bond futures price rises to 97. Mark-to-market the position.*

ANSWER: In this case the FI gains $2,000 since the FI pays only $95,000 for bonds that have a market value of $97,000.

22.9. *The duration of a 20-year, 8 percent coupon Treasury bond selling at par is 10.292 years. The bond's interest is paid semi-annually, and the bond qualifies for delivery against the Treasury bond futures contract.*

a. *What is the modified duration of this bond?*

ANSWER: The modified duration is 10.292/1.04 = 9.896 years.

b. *What is the impact on the Treasury bond price if market interest rates increase 50 basis points?*

ANSWER: $\Delta P = -MD(\Delta R)\$100,000 = -9.896 \times 0.005 \times \$100,000 = -\$4,948.08$.

c. *If you sold a Treasury bond futures contract at 95 and interest rates rose 50 basis points, what would be the change in the value of your futures position?*

ANSWER: $\Delta P = -MD(\Delta R)P = -9.896(0.005)\$95,000 = -\$4,700.67$

d. *If you purchased the bond at par and sold the futures contract, what would be the net value of your hedge after the increase in interest rates?*

ANSWER:

Decrease in market value of the bond purchase	-$4,948.08
Gain in value from the sale of futures contract	$4,700.67
Net gain or loss from hedge	-$247.41

22.12 *Hedge Row Bank has the following balance sheet (in millions):*

Assets	*$150*	*Liabilities*	*$135*
		Equity	*15*
Total	*$150*	*Total*	*$150*

The duration of the assets is six years and the duration of the liabilities is four years. The bank is expecting interest rates to fall from 10 percent to 9 percent over the next year.

a. *What is the duration gap for Hedge Row Bank?*

ANSWER: DGAP = $D_A - k\ D_L = 6 - (0.9)(4) = 6 - 3.6 = 2.4$ years

b. *What is the expected change in net worth for Hedge Row Bank if the forecast is accurate?*

ANSWER: Expected ΔE = -DGAP[ΔR/(1 + R)]A = -2.4(-0.01/1.10)$150m = $3.272 million

c. *What will be the effect on net worth if interest rates increase 110 basis points?*

ANSWER: Expected ΔE = -DGAP[ΔR/(1 + R)]A = -2.4(0.011/1.10)$150 = -$3.6 million.

d. *If the existing interest rate on the liabilities is 6 percent, what will be the effect on net worth of a 1 percent increase in interest rates?*

ANSWER: Solving for the impact on the change in equity under this assumption involves finding the impact of the change in interest rates on each side of the balance sheet, and then determining the difference in these values. The analysis is based on the equation:

Expected $\Delta E = \Delta A - \Delta L$

$\Delta A = -D_A[\Delta R_A/(1 + R_A)]A$ = -6[0.01/1.10]$150m = -$8.1818 million

and $\Delta L = -D_L[\Delta R_L/(1 + R_L)]L$ = -4[0.01/1.06]$135m = -$5.0943 million

Therefore, $\Delta E = \Delta A - \Delta L$ = -$8.1818m – (-$5.0943m) = - $3.0875 million

22.16

Tree Row Bank has assets of $150 million, liabilities of $135 million, and equity of $15 million. The asset duration is six years and the duration of the liabilities is four years. Market interest rates are 10 percent. Tree Row Bank wishes to hedge the balance sheet with Eurodollar futures contracts, which currently have a price quote of $96 per $100 face value for the benchmark three-month Eurodollar CD underlying the contract. The current rate on three-month Eurodollar CDs is 4.0 percent and the duration of these contracts is 0.25 years.

a. *Should the bank go short or long on the futures contracts to establish the correct macrohedge?*

ANSWER: The bank should sell futures contracts since an increase in interest rates would cause the value of the equity and the futures contracts to decrease. But the bank could buy back the futures contracts to realize a gain to offset the decreased value of the equity.

b. *Assuming no basis risk, how many contracts are necessary to fully hedge the bank?*

ANSWER: The number of contracts to hedge the bank is:

$$N_F = \frac{-(D_A - kD_L)A}{D_F \text{ x } P_F} = \frac{-(6-(0.9)4)\$150\text{m}}{0.25 \text{ x } 0.96 \text{x} \$1{,}000{,}000} = -1{,}500 \text{ contracts}$$

c. *Verify that the change in the futures position will offset the change in the cash balance sheet position for a change in market interest rates of plus 100 basis points and minus 50 basis points.*

ANSWER: For an increase in rates of 100 basis points, the change in the cash balance sheet position is: Expected ΔE = -DGAP[$\Delta R/(1 + R)$]A = -2.4(0.01/1.10)$150m = -$3,272,727.27. Since there is no basis risk, [$\Delta R/(1 + R)$] = [$\Delta R_F/(1 + R_F)$], and the change in the value of the $1,000,000 face value futures contract is:

$$\Delta F = -D_F \times N_F \times P_F \times \frac{\Delta R_F}{1+R_F} = -0.25 \times (-1{,}500) \times 0.96 \times \$1{,}000{,}000 \times (0.01/1.10)$$
$$= \$3{,}272{,}727.27$$

For a decrease in rates of 50 basis points, the change in the cash balance sheet position is:

Expected ΔE = -DGAP[$\Delta R/(1 + R)$]A = -2.4(-0.005/1.10)$150m = $1,636,363.64.

The change in the value of the futures contract is:

$$\Delta F = -D_F \times N_F \times P_F \times \frac{\Delta R_F}{1+R_F} = -0.25 \times (-1{,}500) \times 0.96 \times \$1{,}000{,}000 \times (-0.005/1.10)$$
$$= -\$1{,}636{,}363.64$$

d. *If the bank had hedged with Treasury bond futures contracts that had a market value of $95 per $100 of face value, a yield of 8.5295 percent, and a duration of 10.3725 years, how many futures contracts would have been necessary to hedge fully the balance sheet? Assume no basis risk.*

ANSWER: If Treasury bond futures contracts are used, the face value of the contract is $100,000, and the number of contracts necessary to hedge the bank is:

$$N_F = \frac{-(D_A - kD_L)A}{D_F \text{ x } P_F} = \frac{-(6-(0.9)4)\$150\text{m}}{10.3725 \text{ x } \$95{,}000} = \frac{-\$360{,}000{,}000}{\$985{,}387.5} = -365.338509 \text{ contracts}$$

e. *What additional issues should be considered by the bank in choosing between Eurodollar or T-bond futures contracts?*

ANSWER: In cases where a large number of Treasury bonds are necessary to hedge the balance sheet with a macrohedge, the FI may need to consider whether a sufficient number of deliverable Treasury bonds are available. The number of Eurodollar contracts necessary to hedge the balance sheet is greater than the number of Treasury bonds, the Eurodollar market is much deeper and the availability of sufficient deliverable securities should be less of a problem.

22.19 *Reconsider Tree Row Bank in problem 16 but assume that the cost rate on the liabilities is 6 percent. On-balance-sheet rates are expected to increase by 100 basis points. Further, assume there is basis risk such that rates on three-month Eurodollar CDs are expected to change by 0.10 times the rate change on assets and liabilities. That is, $\Delta R_F = 0.10 \times \Delta R$.*

a. *How many contracts are necessary to fully hedge the bank?*

ANSWER: In this case, the bank faces different average interest rates on both sides of the balance sheet. Further, the yield on the Eurodollar CDs underlying the futures contracts is a third interest rate. Thus, the hedge also has the effects of basis risk. Determining the number of futures contracts necessary to hedge this balance sheet must consider separately the effect of a change in rates on each side of the balance sheet, and then consider the combined effect on equity. Estimating the number of contracts can be determined with the modified general equation:

Modified Equation Model:

$$\Delta F + \Delta E = 0$$

$$\Delta F + \Delta A - \Delta L = 0$$

$$\left\{ -D_F (N_F x P_F) x \frac{\Delta R_F}{(1+R_F)} \right\} = -\left\{ -D_A x \frac{\Delta R}{(1+R_A)} x\, A - \left[-D_L x \frac{\Delta R}{(1+R_L)} x\, L \right] \right\} =$$

$$N_F = \frac{-\left\{ D_A x \frac{\Delta R_A}{(1+R_A)} x\, A - D_L x \frac{\Delta R_L}{(1+R_A)} x\, L \right\}}{D_F \; x\, P_F \; x \frac{\Delta R_F}{(1+R_F)}} =$$

$$= -\left(\frac{6x\frac{0.01}{1.10}x150{,}000{,}000 - 4x\frac{0.01}{1.06}x135{,}000{,}000}{0.25x0.96x1{,}000{,}000x\frac{0.10x0.01}{1.04}} \right)$$

$$= \frac{-(\;\$8{,}181{,}8183.18 - \$5{,}094{,}339.63\;)}{\$230.7692308}$$

$$= \frac{-\$3{,}087{,}478.56}{\$230.7692308}$$

$$= -13{,}379.07376\, contracts$$

b. *Verify that the change in the futures position will offset the change in the cash balance sheet position for a change in market interest rates of plus 100 basis points and minus 50 basis points.*

ANSWER: For an increase in rates of 100 basis points, ΔE = -[6 x (0.01/1.01) x $150 m – 4 x (0.01/1.06) x $135 m] = -$3,087,478.56.

The change in the value of the futures contract is:

$$\Delta F = -D_F \times N_F \times P_F \times \frac{\Delta R_F}{1+R_F}$$

= -0.25 x (-13,379.07376) x 0.96 x $1,000,000 x (0.10 x 0.01/1.04)
= $3,087,478.56

For a decrease in rates of 50 basis points, ΔE =

= -[6 x (-0.005/1.10) x $150 m – 4 x (-0.005/1.06) x $135 m] =
= $1,543,739.28.

The change in the value of the futures contract is:

$$\Delta F = -D_F \times N_F \times P_F \times \frac{\Delta R_F}{1+R_F}$$

= -0.25 x (-13,379.07376) x 0.96 x $1,000,000 x (0.10 x (-0.005)/1.04)
= -$1,543,739.28

c. *If the bank had hedged with Treasury bond futures contracts that had a market value of $95 per $100 of face value, a yield to maturity of 8.5295 percent, and a duration of 10.3725 years, how many futures contracts would have been necessary to fully hedge the balance sheet? Assume there is basis risk such that rates on T-bonds are expected to change by 0.75 times the rate change on assets and liabilities. That is,* $\Delta R_F = 0.75 \times \Delta R$.

ANSWER: Estimating the number of contracts can be determined with the modified general equation:

Modified Equation Model:

$$\Delta F + \Delta E = 0$$

$$\Delta F + \Delta A - \Delta L = 0$$

$$\left\{ -D_F (N_F * P_F) * \frac{\Delta R_F}{(1+R_F)} \right\} = -\left\{ -D_A * \frac{\Delta R}{(1+R_A)} * A - \left[-D_L * \frac{\Delta R}{(1+R_L)} * L \right] \right\} =$$

$$N_F = \frac{-\left\{ D_A \, x \, \frac{\Delta R_A}{(1+R_A)} \, xA - D_L \, x \, \frac{\Delta R_L}{(1+R_A)} \, xL \right\}}{D_F x P_F x \frac{\Delta R_F}{(1+R_F)}} =$$

$$= -\left(\frac{6x \frac{0.01}{1.10} x150{,}000{,}000 - 4x \frac{0.01}{1.06} x135{,}000{,}000}{10.3725x0.95x100{,}000x \frac{0.75x0.01}{1.085295}} \right)$$

$$= \frac{-\left(\$8{,}181{,}8183.18 - \$5{,}094{,}339.63 \right)}{6{,}809.582878}$$

$$= \frac{-\$3{,}087{,}478.56}{6{,}809.582878}$$

$$= -453.402009 \text{ contracts}$$

22.20. *A mutual fund plans to purchase $500,000 of 30-year Treasury bonds in four months. These bonds have a duration of 12 years and are priced at 96.25 (percent of face value). The mutual fund is concerned about interest rates changing over the next four months and is considering a hedge with T-bond futures contracts that mature in six months. The T-bond futures contracts are selling for 98-24 (32nds) and have a duration of 8.5 years.*

a. *If interest rate changes in the spot market exactly match those in the futures market, what type of futures position should the mutual fund create?*

ANSWER: The mutual fund needs to buy futures contracts, thus entering into a contract to buy Treasury bonds at 98-24 in four months. The fund manager fears a fall in interest rates (meaning the T-bond's price will increase) and by buying a futures contract, the profit from a fall in rates will offset a loss in the spot market from having to pay more for the securities.

b. *How many contracts should be used?*

ANSWER: The number of contracts can be determined by using the following equation:

$$N_F = \frac{D * P}{D_F * P_F} = \frac{12 * \$481{,}250}{8.5 * \$98{,}750} = 6.88 \text{ contracts}$$

Rounding this up to the nearest whole number is 7.0 contracts.

c. *If the implied rate on the deliverable bond in the futures market moves 12 percent more than the change in the discounted spot rate, how many futures contracts should be used to hedge the portfolio?*

ANSWER: In this case the value of br = 1.12, and the number of contracts is 6.88/1.12 = 6.14 contracts. This may be adjusted downward to 6 contracts.

d. *What causes futures contracts to have a different price sensitivity than the assets in the spot markets?*

ANSWER: One reason for the difference in price sensitivity is that the futures contracts and the cash assets are traded in different markets.

22.21 *Consider the following balance sheet (in millions) for an FI:*

Assets		*Liabilities*	
Duration = 10 years	*$950*	*Duration = 2 years*	*$860*
		Equity	*90*

a. *What is the FI's duration gap?*

ANSWER: The duration gap is 10 - (860/950)(2) = 8.19 years.

b. *What is the FI's interest rate risk exposure?*

ANSWER: The FI is exposed to interest rate increases. The market value of equity will decrease if interest rates increase.

c. *How can the FI use futures and forward contracts to put on a macrohedge?*

ANSWER: The FI can hedge its interest rate risk by selling future or forward contracts.

d. *What is the impact on the FI's equity value if the relative change in interest rates is an increase of 1 percent? That is, $\Delta R/(1+R) = 0.01$.*

ΑΠΑΝΤΗΣΗ: $\Delta E = -8.19(950{,}000)(0.01) = -\$77{,}800$

e. *Suppose that the FI macrohedges using Treasury bond futures that are currently priced at 96. What is the impact on the FI's futures position if the relative change in all interest rates is an increase of 1 percent? That is, $\Delta R/(1+R) = 0.01$. Assume that the deliverable Treasury bond has a duration of nine years.*

ΑΠΑΝΤΗΣΗ: $\Delta F = -9(96{,}000)(0.01) = -\$8{,}640$ per futures contract. Since the macrohedge is a short hedge, this will be a profit of $8,640 per contract.

f. *If the FI wants to macrohedge, how many Treasury bond futures contracts does it need?*

ANSWER: To macrohedge, the Treasury bond futures position should yield a profit equal to the loss in equity value (for any given increase in interest rates). Thus, the number of futures contracts must be sufficient to offset the $77,800 loss in equity value. This will necessitate the sale of $77,800/8,640 = 9.005 contracts. Rounding down, to construct a macrohedge requires the FI to sell 9 Treasury bond futures contracts.

22.22 *Refer again to problem 21. How does consideration of basis risk change your answers to problem 21?*

ANSWER: In problem 21, we assumed that basis risk did not exist. That allowed us to assert that the percentage change in interest rates ($\Delta R/(1+R)$) would be the same for both the futures and the underlying cash positions. If there is basis risk, then ($\Delta R/(1+R)$) is not necessarily equal to ($\Delta R_f/(1+R_f)$). If the FI wants to fully hedge its interest rate risk exposure in an environment with basis risk, the required number of futures contracts must reflect the disparity in volatilities between the futures and cash markets.

a. *Compute the number of futures contracts required to construct a macrohedge if $[\Delta R_f/(1+R_f) / \Delta R/(1+R)] = br = 0.90$*

ANSWER: If *br* = 0.9, then: $N_f = \dfrac{-(D_A - k\,D_L)\,A}{D_F\,P_F\,br} = \dfrac{-8.19(950{,}000)}{(9)(96{,}000)(0.90)} = -10 \text{ contracts}$

b. *Explain what is meant by br = 0.90.*

ANSWER: br = 0.90 means that the implied rate on the deliverable bond in the futures market moves by 0.9 percent for every 1 percent change in discounted spot rates ($\Delta R/(1+R)$).

c. *If br = 0.90, what information does this provide on the number of futures contracts needed to construct a macrohedge?*

ANSWER: If *br* = 0.9 then the percentage change in cash market rates exceeds the percentage change in futures market rates. Since futures prices are less sensitive to interest rate shocks than cash prices, the FI must use more futures contracts to generate sufficient cash flows to offset the cash flows on its balance sheet position.

22.23 *An FI is planning to hedge its $100 million bond instruments with a cross hedge using Eurodollar interest rate futures. How would the FI estimate*

$$br = [\Delta R_f/(1+R_f) \,/\, \Delta R/(1+R)]$$

to determine the exact number of Eurodollar futures contracts to hedge?

ANSWER: One way of estimating br (or the ratio of changes in yields of futures to the yields on the underlying security) involves regressing the changes in bond yields against Eurodollar futures. The estimated slope of the line *br* provides the exact number of contracts needed to hedge. Note that historical estimation of the basis risk is not a guarantee that it will remain the same in the future.

22. 25 *Assume an FI has assets of $250 million and liabilities of $200 million. The duration of the assets is six years and the duration of the liabilities is three years. The price of the futures contract is $115,000 and its duration is 5.5 years.*

a. *What number of futures contracts is needed to construct a perfect hedge if br = 1.10?*

ANSWER:

$$N_f = \frac{-(D_A - k\, D_L)A}{(D_f \; x \, P_f \; x br)} = \frac{-[6-(0.8x3)]\$250{,}000{,}000}{5.5x\$115{,}000x1.10} = \frac{-\$900{,}000{,}000}{\$695{,}750} = -1{,}293.57\, contracts$$

b. *If $\Delta R_f/(1+R_f) = 0.0990$, what is the expected $\Delta R/(1+R)$?*

ANSWER: br = $(\Delta R_f/(1+R_f))/(□R/(1 + R))$ => $□R/(1 + R) = (\Delta R_f/(1+R_f))/br = 0.0990/1.10 = 0.09$

24.4. *An insurance company owns $50 million of floating-rate bonds yielding LIBOR plus 1 percent. These loans are financed with $50 million of fixed-rate guaranteed investment contracts (GICs) costing 10 percent. A bank has $50 million of auto loans with a fixed rate of 14 percent. The loans are financed with $50 million of CDs at a variable rate of LIBOR plus 4 percent.*

a. *What is the risk exposure of the insurance company?*

ANSWER: The insurance company (IC) is exposed to falling interest rates on the asset side of the balance sheet.

b. *What is the risk exposure of the bank?*

ANSWER: The bank is exposed to rising interest rates on the liability side of the balance sheet.

c. *What would be the cash flow goals of each company if they were to enter into a swap arrangement?*

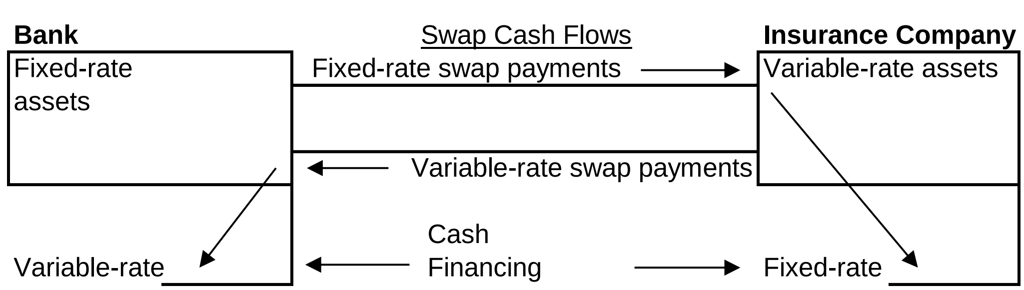
ANSWER: The IC wishes to convert the fixed-rate liabilities into variable-rate liabilities by swapping the fixed-rate payments for variable-rate payments. The bank wishes to convert variable-rate liabilities into fixed-rate liabilities by swapping the variable-rate payments for fixed-rate payments.

d. *Which FI would be the buyer and which FI would be the seller in the swap?*

ANSWER: The bank will make fixed-rate payments and therefore is the buyer in the swap. The IC will make variable-rate payments and therefore is the seller in the swap.

e. *Diagram the direction of the relevant cash flows for the swap arrangement.*

ANSWER: Please see the diagram at the top of the next page. Note that the fixed-rate swap payments from the bank to the insurance company will offset the payments on the fixed-rate liabilities that the insurance company has incurred. The reverse situation occurs regarding the variable-rate swap payments from the insurance company to the bank. Depending on the rates negotiated and the maturities of the assets and liabilities, both FIs now have durations much closer to zero on this portion of their respective balance sheets.



f. What are reasonable cash flow amounts, or relative interest rates, for each of the payment streams?

ANSWER: Determining a set of reasonable interest rates involves an analysis of the benefits to each FI. That is, does each FI pay lower interest rates with the swap than contractually obligated without the swap? Clearly, the direction of the cash flows will help reduce interest rate risk.

One feasible swap is for the IC to pay the bank LIBOR + 2.5 percent, and for the bank to pay the IC 12 percent. The net financing cost for each firm is given below.

	Bank	Insurance Company
Cash market liability rate	LIBOR + 4%	10.0%
Minus swap rate	-(LIBOR + 2.5%)	-12.0%
Plus swap rate	+ 12%	+(LIBOR + 2.5%)
Net financing cost (rate)	13.5%	LIBOR + 0.5%

Whether the two firms would negotiate these rates depends on the relative negotiating power of each firm, and the alternative rates for each firm in the alternate markets. That is, the fixed-rate liability market for the bank and the variable-rate liability market for the insurance company.

24.6 *A commercial bank has $200 million of four-year maturity floating-rate loans yielding the T-bill rate plus 2 percent. These loans are financed with $200 million of four-year maturity fixed-rate deposits costing 9 percent. The commercial bank can issue four-year variable-rate deposits at the T-bill rate plus 1.5 percent. A savings bank has $200 million of four-year maturity mortgages with a fixed rate of 13 percent. They are financed with $200 million of four-year maturity CDs with a variable rate of the T-bill rate plus 3 percent. The savings bank can issue four-year long-term debt at 12.5 percent.*

a. Discuss the type of interest rate risk each FI faces.

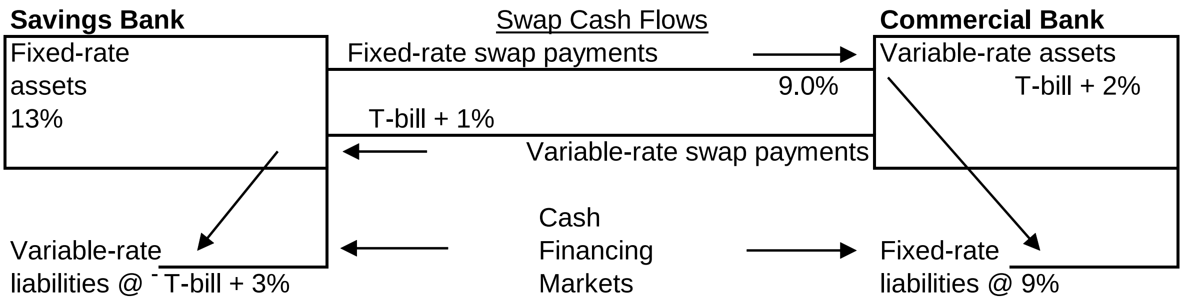
ANSWER: The commercial bank is exposed to a decrease in rates that would lower interest income, while the savings bank is exposed to an increase in rates that would increase interest expense. In either case, profit performance would suffer.

b. Propose a swap that would result in each FI having the same type of asset and liability cash flows.

ANSWER: One feasible swap would be for the commercial bank to send variable-rate payments of the T-bill rate + 1 percent (T-bill + 1%) to the savings bank and to receive fixed-rate payments of 9 percent from the savings bank.

c. Show that this swap would be acceptable to both parties.

ANSWER: The swap flows are shown below.



Given these patterns of cash flows associated with the swap, the commercial bank and savings bank will realize the following financing costs.

	Savings Bank	Commercial Bank
Cash market liability rate	T-bill + 3%	9%
Minus swap rate	-(T-bill + 1%)	-9%
Plus swap rate	+ 9%	+(T-bill + 1%)
Net financing cost rate	11%	T-bill + 1%
Rate available on:		
Variable-rate debt	12.5%	
Fixed-rate debt		T-bill + 1.5%

As a result of the swap, the bank has transformed its four-year, fixed-rate interest payments into variable-rate payments, matching the variability of returns on its assets. Further, through the interest rate swap, the bank effectively pays T-bill plus 1 percent for its financing. Had it gone to the debt market, the bank would pay T-bill plus 1.5 percent. Thus, the swap allows the bank to manage its interest rate risk at an overall savings of 0.5 percent better than market rates. The savings bank has transformed its variable-rate interest payments into fixed-rate payments, matching the fixed rate of return on its assets. Further, through the interest rate swap, the savings bank effectively pays 11 percent for its financing. Had it gone to the debt market, the bank would pay 12.5 percent. Thus, the swap allows the savings bank to manage its interest rate risk at an overall savings of 1.5 percent better than market rates.

d. The realized T-bill rates over the four-year contract period are as follows:

End of Year	*T-bill Rate*
1	*1.75%*
2	*2.00*
3	*2.25*
4	*2.50*

Calculate the realized cash flows on the swap and the net interest yield for the savings bank and the commercial bank over the contract period.

ANSWER: The realized cash flows on the swap agreement are as follows:

End of Year	T-bill rate	T-bill rate + 1%	Cash Payment by bank	Cash payment by savings bank	Net payment made by savings bank
1	1.75%	2.75%	$5.5m	$22m	$16.5m
2	2.00	4.00	8.0m	22m	14.0m
3	2.25	4.25	8.5m	22m	13.5m
4	2.50	3.50	7.0m	22m	15.0m

The net interest yield on the assets minus the cost of liabilities plus the swap for the commercial bank is locked at 1 percent [(T-bill + 2%) – (T-bill + 1%)] for the four-year swap contract period. The net interest yield on the assets minus the cost of liabilities plus the swap for the savings bank is locked at on is 2 percent (13% - 11%) for the four-year swap contract period.

An adjustment to make the net interest yield equal at 1.5 percent would be to have the savings bank pay a fixed rate of 9.5 percent or receive a variable rate of T-bill + 0.5 percent. Obviously, many rate combinations could be negotiated to achieve acceptable rate spreads and to achieve the desired interest rate risk management goals.

e. What are some of the practical difficulties in arranging this swap?

ANSWER: The floating rate assets may not be tied to the same rate as the floating rate liabilities. This would result in basis risk. Also, if the mortgages are amortizing, the interest payments would not match those on the notional amount of the swap.

24.7 *Bank 1 can issue five-year CDs at an annual rate of 11 percent fixed or at a variable rate of LIBOR plus 2 percent. Bank 2 can issue five-year CDs at an annual rate of 13 percent fixed or at a variable rate of LIBOR plus 3 percent.*

a. Is a mutually beneficial swap possible between the two banks?

ANSWER: A mutually beneficial swap exists because comparative advantage exists.

b. Where is the comparative advantage of the two banks?

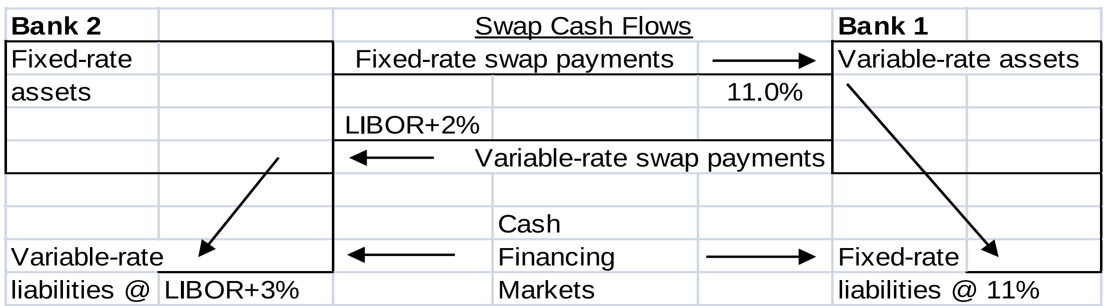
ANSWER: Bank 1 has a comparative advantage in the fixed-rate market because the difference in fixed rates is 2 percent in favor of Bank 1. Bank 2 has the comparative advantage in the variable-rate market because the difference in variable rates is only –1 percent against Bank 1. One way to compare the rate alternatives is to utilize the following matrix.

	Fixed Rate	Variable Rate
Bank 1	11%	LIBOR + 2%
Bank 2	13%	LIBOR + 3%
Difference	-2%	-1%

c. *What is an example of a feasible swap?*

<u>ANSWER</u>: Many rate combinations are possible to achieve a reduced interest charge. The following is a framework to achieve the outside boundaries of acceptable interest rates using the matrix of possible rates shown in part (b).

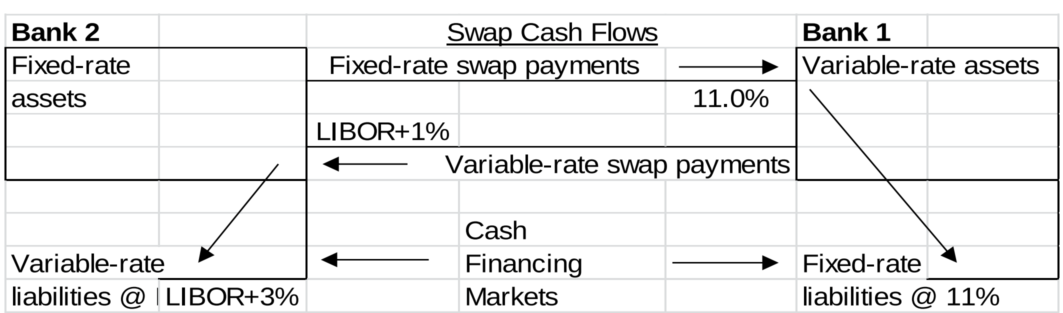
Using the rates shown for Bank 1 as the negotiated swap rates will give the entire interest rate advantage to Bank 2. The diagram and payoff matrix below verifies this case.



The relative payoffs are given below:

	Bank 2	Bank 1
Cash market liability rate	LIBOR+3%	11%
Minus swap rate	-(LIBOR+2%)	-11%
Plus swap rate	+ 11%	+(LIBOR+2%)
Net financing cost (rate)	12.0%	LIBOR+2%

Bank 1 is paying the rate it could achieve in the variable rate market. Thus, Bank 1 receives no benefit to these swap rates. Now consider the rates shown for Bank 2 in the matrix of rates in part (b).



In this case, Bank 2 is receiving the exact rate it owes on the liabilities and it is paying the rate necessary if it was in the fixed-rate market. Bank 1 receives the entire 1 percent benefit as it is paying net 1 percent less than it would need to pay in the variable-rate market.

The relative payoffs are given below:

	Bank 2	Bank 1
Cash market liability rate	LIBOR+3%	11%
Minus swap rate	-(LIBOR+1%)	-11%
Plus swap rate	+ 11%	+(LIBOR+1%)
Net financing cost rate	13%	LIBOR+1%

Any swap rate combination between these two boundaries that yields a total saving in combined interest cost becomes a feasible set of negotiated swap rates. The exact set of rates will depend on negotiating position of each bank and the expected interest rates over the life of the swap. As an example, consider the average of the two fixed-rate payments and the average of the two variable-rate payments. The relative payoffs are given below:

	Bank 2	Bank 1
Cash market liability rate	LIBOR+3.0%	11.0%
Minus swap rate	-(LIBOR+2.5%)	-12.0%
Plus swap rate	+ 12.0%	+(LIBOR+2.5%)
Net financing cost rate	12.5%	LIBOR+1.5%

In each case, the banks are paying 0.5 percent less than they would in the relative desired cash markets.

24.8

First Bank can issue one-year, floating-rate CDs at prime plus 1 percent or fixed-rate CDs at 12.5 percent. Second Bank can issue one-year, floating-rate CDs at prime plus 0.5 percent or fixed-rate at 11.0 percent.

a. *What is a feasible swap with all of the benefits going to First Bank?*

ANSWER: The possible interest rate alternatives faced by each firm are given below:

	Fixed Rate	Variable Rate
First Bank	12.5%	Prime+1.0%
Second Bank	11.0%	Prime+0.5%
Difference	1.5%	0.5%

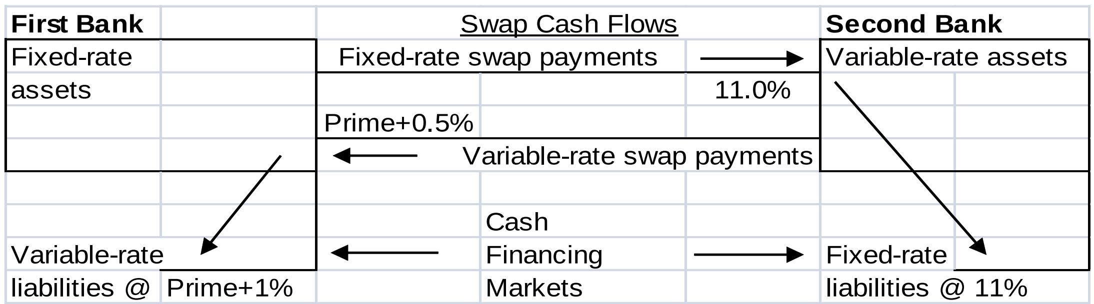
The interest rate difference is 1.5 – 0.5 = 1.0 percent. Second Bank has the comparative advantage in the fixed-rate market and First Bank has the comparative advantage in the variable-rate market. A set of swap rates within the feasible boundaries that will give all the benefits to First Bank is 11 percent fixed rate and Prime + 0.5 percent variable rate.

b. *What is a feasible swap with all of the benefits going to Second Bank?*

ANSWER: A set of rates within the feasible boundaries that will give all the benefits to Second Bank is 12.5 percent fixed rate and Prime + 1.0 percent variable rate.

c. *Diagram each situation.*

ANSWER: Diagram of all the benefits going to First Bank.

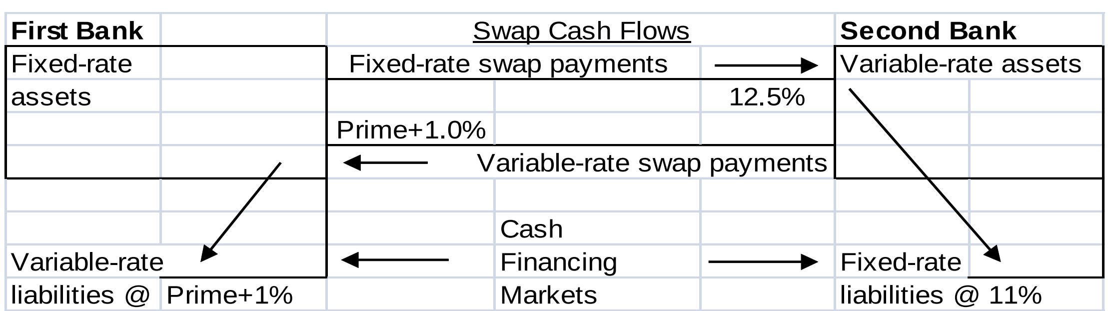


The payoff matrix that demonstrates that all of the benefits go to First Bank follows.

	First Bank	Second Bank
Cash market liability rate	Prime+1%	11.0%
Minus swap rate	-(Prime+0.5%)	-11.0%
Plus swap rate	+ 11%	+(Prime+0.5%)
Net financing cost rate	11.5%	Prime+0.5%

The net cost for First Bank is 11.5 percent, or 1 percent less than it would pay in the fixed-rate cash market. The net cost for Second Bank is exactly the same as it would pay in the variable-rate cash market.

Diagram of all the benefits going to Second Bank.



The net cost for First Bank is 12.5 percent, which is exactly what it would pay in the fixed-rate cash market. The net cost for Second Bank is Prime - 0.5 percent, or 1 percent less than it would pay in the variable-rate cash market. The payoff matrix that illustrates that all of the benefits go to Second Bank follows.

	First Bank	Second Bank
Cash market liability rate	Prime+1%	11.0%
Minus swap rate	-(Prime+1%)	-12.5%
Plus swap rate	+ 12.5%	+(Prime+1%)
Net financing cost rate	12.5%	Prime-0.5%

d. What factors will determine the final swap arrangement?

<u>ANSWER</u>: The primary factor that will determine the final distribution of the swap rates is the present value of the cash flows for the two parties. The most important no-arbitrage condition is that the present value of the expected cash flows made by the buyer should equal the present value of the expected cash flows made by the seller. Secondary factors include the negotiating strengths of either party to the transaction.