###### Solutions for End-of-Chapter Questions and Problems: Chapter Twenty-Two

1. What are derivative contracts? What is the value of derivative contracts to the managers of FIs? Which type of derivative contracts had the highest notional value outstanding among all U.S. banks as of June 2012?

Derivatives are financial assets whose value is determined by the value of some underlying asset. As such, derivative contracts are instruments that provide the opportunity to take some action at a later date based on an agreement to do so at the current time. Although the contracts differ, the price, timing, and extent of the later actions are usually agreed upon at the time the contracts are arranged. Normally, the contract values depend on the activity of the underlying asset.

Derivative contracts have value to managers of FIs because of their ability to help in managing the various types of risk prevalent in the institutions. As of June 2012 the largest category of derivatives in use by commercial banks was swaps, followed by futures and forwards, and then options.

1. What are some of the major differences between futures and forward contracts? How do these contracts differ from spot contracts?

A spot contract is an exchange of cash, or immediate payment, for financial assets, or any other type of assets, at the time the agreement to transact business is made, i.e., at time 0. Futures and forward contracts both are agreements between a buyer and a seller at time 0 to exchange the asset for cash (or some other type of payment) at a later time in the future. The specific grade and quantity of asset is identified at time 0, as is the specific price paid and time the transaction will eventually occur.

One of the differences between futures and forward contracts is the uniqueness of forward contracts because they are negotiated between two parties. On the other hand, futures contracts are standardized because they are offered by and traded on an exchange. Futures contracts are marked to market daily by the exchange and the exchange guarantees the performance of the contract to both parties. Thus, the risk of default by either party is minimized from the viewpoint of the other party. No such guarantee exists for a forward contract. Finally, delivery of the asset almost always occurs for forward contracts, but seldom occurs for futures contracts. Instead, an offsetting or reverse transaction occurs through the exchange prior to the maturity of the contract.

1. What is a naive hedge? How does a naive hedge protect an FI from risk?

A hedge involves protecting the price of or return on an asset from adverse changes in price or return in the market. A naive hedge usually involves the use of a derivative instrument that has the same underlying asset as the asset being hedged. Thus, if a change in the price of the cash asset results in a gain, the same change in market value will cause the derivative instrument to generate a loss that offsets the gain in the cash asset.

1. 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.

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.

1. Contrast the position of being short with that of being long in futures contracts.

To be short in futures contracts means that you have agreed to sell the underlying asset at a future time, while being long means that you have agreed to buy the asset at a later time. In each case, the price and the time of the future transaction are agreed upon when the contracts are initially negotiated.

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?

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?

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?

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.

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.

7. Long Bank has assets that consist mostly of 30-year mortgages and liabilities that are short-term demand and time deposits. Will an interest rate futures contract the bank buys add to or subtract from the bank’s risk?

The purchase of an interest rate futures contract will add to the risk of the bank. If rates increase in the market, the value of the bank’s assets will decrease more than the value of the liabilities. In addition, the value of the futures contract also will decrease. Thus, the bank will suffer decreases in value both on and off the balance sheet. If the bank had sold the futures contract, the increase in rates would have resulted in the futures position producing a gain that would offset (at least partially) the loss in value on the balance sheet.

8. In each of the following cases, indicate whether it would be appropriate for an FI to buy or sell a forward contract to hedge the appropriate risk.

a. A commercial bank plans to issue CDs in three months.

The bank should sell a forward contract to protect against an increase in interest rates.

b. An insurance company plans to buy bonds in two months.

The insurance company should buy a forward contract to protect against a decrease in interest rates.

c. A savings bank is going to sell Treasury securities it holds in its investment portfolio next month.

The savings bank should sell a forward contract to protect against an increase in interest rates.

d. A U.S. bank lends to a French company. The loan is payable in euros.

The bank should sell euros forward to protect against a decrease in the value of the euro, or an increase in the value of the dollar.

e. A finance company has assets with a duration of six years and liabilities with a duration of 13 years.

The finance company should buy a forward contract to protect against decreasing interest rates that would cause the value of liabilities to increase more than the value of assets, thus causing a decrease in equity value.

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 semiannually, and the bond qualifies for delivery against the Treasury bond futures contract.

a. What is the modified duration of this bond?

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?

ΔP = -MD(ΔR)$100,000 = -9.896 x 0.005 x $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?



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?

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

10. What are the differences between a microhedge and a macrohedge for a FI? Why is it generally more efficient for FIs to employ a macrohedge than a series of microhedges?

A microhedge uses a derivative contract such as a forward or futures contract to hedge the risk exposure of a specific transaction, while a macrohedge is a hedge of the duration gap of the entire balance sheet. FIs that attempt to manage their risk exposure by hedging each balance sheet position will find that hedging is excessively costly, because the use of a series of microhedges ignores the FI’s internal hedges that are already on the balance sheet. That is, if a long-term fixed-rate asset position is exposed to interest rate increases, there may be a matching long-term fixed-rate liability position that also is exposed to interest rate decreases. Putting on two microhedges to reduce the risk exposures of each of these positions fails to recognize that the FI has already hedged much of its risk by taking matched balance sheet positions. The efficiency of the macrohedge is that it focuses only on those mismatched positions that are candidates for off-balance-sheet hedging activities.

11. What are the reasons why an FI may choose to hedge selectively its portfolio?

Selective hedging involves an explicit attempt to not minimize the risk on the balance sheet. An FI may choose to hedge selectively in an attempt to improve profit performance by accepting some risk on the balance sheet, or to arbitrage profits between a spot asset’s price movements and the price movements of the futures price. This latter situation often occurs because of differential changes in interest rates caused in part by cross-hedging.

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?

DGAP = DA – k DL = 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?

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?

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?

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 ΔE = ΔA - ΔL

ΔA = -DA[ΔRA/(1 + RA)]A = -6[0.01/1.10]$150m = -$8.1818 million

and ΔL = -DL[ΔRL/(1 + RL)]L = -4[0.01/1.06]$135m = -$5.0943 million

Therefore, ΔE = ΔA - ΔL = -$8.1818m – (-$5.0943m) = - $3.0875 million

13. For a given change in interest rates, why is the sensitivity of the price of a Treasury bond futures contract greater than the sensitivity of the price of a Treasury bill futures contract?

The price sensitivity of a futures contract depends on the duration of the asset underlying the contract. In the case of a T-bill contract, the duration is 0.25 years. In the case of a T-bond contract, the duration is much longer.

14. What is the meaning of the Treasury bond futures price quote 101‑130?

A quote of 101 ‑ 130 = $101 13/32 per $100 face value. Since Treasury bond futures contracts are for $100,000 face value, the quoted price is $101,406.25.

15. What is meant by fully hedging the balance sheet of an FI?

Fully hedging the balance sheet involves using a sufficient number of futures contracts so that any loss (or gain) of net worth on the balance sheet is just offset by the gain (or loss) from the off-balance-sheet use of futures contracts for given changes in interest rates.

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?

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?

The number of contracts to hedge the bank is:



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.

For an increase in rates of 100 basis points, the change in the cash balance sheet position is: Expected ΔE = -DGAP[ΔR/(1 + R)]A = -2.4(0.01/1.10)$150m = -$3,272,727.27.

Since there is no basis risk, [ΔR/(1 + R)] = [ΔRF/(1 + RF)], and the change in the value of the $1,000,000 face value futures contract is:

 = -0.25 x (-1,500) x 0.96 x $1,000,000 x (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[ΔR/(1 + R)]A = -2.4(-0.005/1.10)$150m = $1,636,363.64.

The change in the value of the futures contract is:

 = -0.25 x (-1,500) x 0.96 x $1,000,000 x (-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.

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:



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

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.

17. What is basis risk? What are the sources of basis risk?

Basis risk is the lack of perfect correlation between changes in the yields of the on-balance-sheet assets or liabilities and changes in interest rates on the futures contracts. The reason for this difference is that the cash assets and the futures contracts are traded in different markets.

18. How would your answer for part (b) in problem 16 change if the relationship of the price sensitivity of futures contracts to the price sensitivity of underlying bonds were br = 0.92?

The number of contracts to hedge the bank is:



The number of contracts necessary to hedge the bank would increase to 1,630.434783 contracts.

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, ΔRF = 0.10 x ΔR.

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

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:



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.

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:



= -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:



= -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, ΔRF = 0.75 x ΔR.

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

Modified Equation Model:



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?

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?

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



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?

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?

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

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?

The duration gap is 10 ‑ (860/950)(2) = 8.19 years.

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

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?

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, ΔR/(1+R) = 0.01.

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, ΔR/(1+R) = 0.01. Assume that the deliverable Treasury bond has a duration of nine years.

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?

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

In problem 21, we assumed that basis risk did not exist. That allowed us to assert that the percentage change in interest rates (ΔR/(1+R)) would be the same for both the futures and the underlying cash positions. If there is basis risk, then (ΔR/(1+R)) is not necessarily equal to (ΔRf/(1+Rf)). 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

[ΔRf/(1+Rf) / ΔR/(1+R)] = br = 0.90

If *br* = 0.9, then: 

b. Explain what is meant by br = 0.90.

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 (ΔR/(1+R)).

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

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.

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 = [ΔRf/(1+Rf) / ΔR/(1+R)]

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

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.

24. Village Bank has $240 million worth of assets with a duration of 14 years and liabilities worth $210 million with a duration of 4 years. In the interest of hedging interest rate risk, Village Bank is contemplating a macrohedge with interest rate T-bond futures contracts now selling for 102-21 (32nds). The T-bond underlying the futures contract has a duration of nine years. If the spot and futures interest rates move together, how many futures contracts must Village Bank sell to fully hedge the balance sheet?



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?



b. If ΔRf/(1+Rf) = 0.0990, what is the expected ΔR/(1+R)?

br = (ΔRf/(1+Rf))/(R/(1 + R)) => R/(1 + R) = (ΔRf/(1+Rf))/br = 0.0990/1.10 = 0.09

26. Suppose an FI purchases a $1 million 91-day (360-day year) Eurodollar futures contract trading at 98.50.

a. If the contract is reversed two days later by selling the contract at 98.60, what is the net profit?

Profit = (0.9860 - 0.9850) x 91/360 x 1,000,000 = $252.78

b. What is the loss or gain if the price at reversal is 98.40?

Loss = (0.9840 - 0.9850) x 91/360 x 1,000,000 = -$252.78

27. Dudley Hill Bank has the following balance sheet:

Assets (in millions) Liabilities and Equity (in millions)

A $425 L $380

E 45

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$425 $425

Further, *DA* = 6 years

*DL* = 2 years

The bank manager receives information from an economic forecasting unit that interest rates are expected to rise from 8 to 9 percent over the next six months.

a. Calculate the potential loss to Dudley Hill’s net worth (*E*) if the forecast of rising rates proves to be true.

, so that  -$16,574,074

The bank could expect to lose $16,574,074 in shareholders’ net worth should the interest rate forecast be accurate. Since the FI started with a net worth of $45 million, the loss of $16,574,074 is almost 37 percent of its initial net worth position.

b. Suppose the manager of Dudley Hill Bank wants to hedge this interest rate risk with T-bond futures contracts. The current futures price quote is $122.03125 per $100 of face value for the benchmark 20-year, and the minimum contract size is $100,000, so PF equals $122,031.25. The duration of the deliverable bond is 14.5 years. That is, DF = 14.5 years. How many futures contracts will be needed? Should the manager buy or sell these contracts? Assume no basis risk.

From the equation for *NF*, we can now solve for the correct number of futures positions to sell (*NF*).

 

Since the bank is exposed to interest rate increases, it should sell these contracts.

c. Verify that selling T-bond futures contracts will indeed hedge the FI against a sudden increase in interest rates from 8 to 9 percent, a 1 percent, interest rate shock.

**On-Balance-Sheet:** As shown above, when interest rates rise by 1 percent, the FI loses $16,574,074 in net worth (∆*E*) on the balance sheet:

 -$16,574,074

**Off-Balance-Sheet:** Since there is no basis risk, [ΔR/(1 + R)] = [ΔRF/(1 + RF)], and the change in the value of the futures position is:

 $16,574,074

The value of the off-balance-sheet futures position (∆*F*) falls by $16,574,074 when the

FI sells 1,011.61192 futures contracts in the T-bond futures market. Such a fall in value of the futures contracts means a positive cash flow to the futures seller as the buyer compensates the seller for a lower futures price through the marking-to-market process.

d. If the bank had hedged with Eurodollar futures contracts that had a market value of $98 per $100 of face value, how many futures contracts would have been necessary to hedge fully the balance sheet?

If futures contracts are used, the duration of the underlying asset is 0.25 years, the face value of the contract is $1,000,000, and the number of contracts necessary to hedge the bank is:



e. How would your answer for part (b) change if the relationship of the price sensitivity of futures contracts to the price sensitivity of underlying bonds were br = 1.15?

The number of contracts to hedge the bank is:



The number of contracts necessary to hedge the bank would decrease to 879.6626015 contracts.

f. Verify that selling T-bond futures contracts will indeed hedge the FI against a sudden increase in interest rates from 8 to 9 percent, a 1 percent, interest rate shock. Assume the yield on the T-bond underlying the futures contract is 8.45 percent as the bank enters the hedge, and rates rise by 1.154792 percent.

**On-Balance-Sheet:** As shown above, when interest rates rise by 1 percent, the FI loses $16,574,074 in net worth (∆*E*) on the balance sheet:

 -$16,574,074

**Off-Balance-Sheet:** When interest rates rise by 1.154792 percent on the T-bond underlying the futures contract, the change in the value of the futures position is:

 $16,574,079

28. An FI has an asset investment in euros. The FI expects the exchange rate of $/€ to increase by the maturity of the asset.

a. Is the dollar appreciating or depreciating against the euro?

The dollar is depreciating as it will take more dollars per € in the future.

b. To fully hedge the investment, should the FI buy or sell euro futures contracts?

The FI should buy € futures.

c. If there is perfect correlation between changes in the spot and futures contracts, how should the FI determine the number of contracts necessary to hedge the investment fully?

A sufficient number of futures contracts should be purchased so that a profit (loss) on the futures position will just offset a loss (profit) on the asset portfolio. If there is perfect correlation between the spot and futures prices, the number of futures contracts can be determined by dividing the value of the foreign currency asset portfolio by the foreign currency size of each contract. If the spot and futures prices are not perfectly correlated, the value of the long asset position at maturity must be adjusted by the hedge ratio before dividing by the size of the futures contract.

29. What is meant by tailing the hedge? What factors allow an FI manager to tail the hedge effectively?

Gains from futures contract positions typically are received throughout the life of the hedge from the process of marking to market the futures position. These gains can be reinvested to generate interest income cash flows that reduce the number of futures contracts needed to hedge an original cash position. Higher short-term interest rates and less uncertainty in the pattern of expected cash flows from marking to market the futures position will increase the effectiveness of this process.

30. What does the hedge ratio measure? Under what conditions is this ratio valuable in determining the number of futures contracts necessary to hedge fully an investment in another currency?

The hedge ratio measures the relative sensitivity of futures prices to changes in the spot exchange rates. This ratio is particularly helpful when the changes in futures prices are not perfectly correlated with the changes in the spot exchange rates.

31. What technique is commonly used to estimate the hedge ratio? What statistical measure is an indicator of the confidence that should be placed in the estimated hedge ratio? What is the interpretation if the estimated hedge ratio is greater than 1? Less than 1?

A common method to estimate the hedge ratio is to regress recent changes in spot prices on recent changes in futures prices. The degree of confidence is measured by the value of R2 for the regression. A value of R2 equal to one implies perfect correlation between the two price variables. The estimated slope coefficient (β) from the regression equation is the estimated hedge ratio or measure of sensitivity between spot prices and futures prices. A value of β greater than one means that changes in spot prices are greater than changes in futures prices, and the number of futures contracts must be increased accordingly. A value of β less than one means that changes in spot prices are less than changes in futures prices, and the number of futures contracts can be decreased accordingly.

32. An FI has assets denominated in British pounds of $125 million and pound liabilities of $100 million. The exchange rate of dollars for pounds is currently $1.60/£.

a. What is the FI's net exposure?

The net exposure is $125 million - $100 million = $25 million.

b. Is the FI exposed to a dollar appreciation or depreciation?

The FI is exposed to dollar appreciation, or declines in the pound relative to the dollar.

c. How can the FI use futures or forward contracts to hedge its FX rate risk?

The FI can hedge its FX rate risk by selling forward or futures contracts in pounds, assuming the contracts are quoted as $/£, that is, in direct quote terms in the U.S.

d. If a futures contract is currently trading at $1.55/£, what is the number of futures contracts that must be utilized to fully hedge the FI's currency risk exposure? Assume the contract size on the British pound futures contract is £62,500.

Assuming that the contract size for British pounds is £62,500, the FI must sell Nf = ($25 million/1.55)/£62,500 = 258 pound sterling futures contracts.

e. If the British pound exchange rate falls from $1.60/£ to $1.50/£, what will be the impact on the FI's cash position?

The cash position will experience a loss if the pound depreciates in terms of the U.S. dollar. The loss would be equal to (($25 million/$1.60) x 1.50) ‑ $25 million = $23,437,500 ‑ $25 million = -$1,562,500.

f. If the British pound futures exchange rate falls from $1.55/£ to $1.45/£, what will be the impact on the FI's futures position?

The gain on the short futures hedge is:

*NF* x £62,500 x F*t* = ‑258(£62,500)($1.45 ‑ $1.55) = +$1,612,500

g. Using the information in parts (e) and (f ), what can you conclude about basis risk?

In cases where basis risk occurs, a perfect hedge is not possible.

33. An FI is planning to hedge its one-year, 100 million Swiss franc (SF)-denominated loan against exchange rate risk. The current spot rate is $0.60/SF. A 1-year SF futures contract is currently trading at $0.58/SF. SF futures are sold in standardized units of SF125,000.

a. Should the FI be worried about the SF appreciating or depreciating?

The FI should be worried about the SF depreciation because it will provide fewer dollars per SF.

b. Should the FI buy or sell futures to hedge against exchange rate risk exposure?

The FI should sell SF futures contracts to hedge this exposure.

c. How many futures contracts should the FI buy or sell if a regression of past changes in the spot exchange rates on changes in future exchange rates generates an estimated slope of 1.4?

*Nf* = (Long asset position x h/(Futures contract size) = SF100m x 1.4/SF125,000 = 1,120 contracts

d. Show exactly how the FI is hedged if it repatriates its principal of SF100 million at year-end, the spot exchange rate of SF at year-end is $0.55/SF, and the forward exchange rate is $0.5443/SF.

The original loan in dollars = SF100 x $0.60 = $60 million, and the loan value in dollars at year-end = SF100 x $0.55 = $55 million. The balance sheet has decreased in value by $5,000,000. The gain from hedge = ($0.58 - $0.5443) x SF125,000 x 1,120 = $4,998,000. The net loss is reduced to just $2,000 by hedging the FX rate risk.

34. A U.S. FI has a long position in £75,500,000 assets funded with U.S. dollar denominated liabilities. The FI manager is concerned about the £ appreciating relative to the dollar and is considering a hedge of this FX risk using £ futures contracts. The manager has regressed recent changes in spot £ exchange rates on changes in £ futures contracts. The resulting regression equation is: ΔSt = 0.09 + 1.5ΔFt. Further, the Cov(ΔSt, ΔFt) was found to be 0.06844, σΔSt = 0.3234, and σΔft = 0.2279. Pound futures contracts are sold in standardized units of £62,500. Calculate the number of futures contracts needed to hedge the risk of the £75,500,000 asset. Calculate the hedging effectiveness of these futures contracts. To what extent can the manager have confidence that the correct hedge ratio is being used to hedge the FI’s FX risk position?



R2 = [0.06844/(0.3234 x 0.2279)]2 = 86.23%

The manager can have high confidence that the correct hedge ratio is being used to hedge the FI’s FX risk position.

35. An FI has made a loan commitment of SF10 million that is likely to be taken down in six months. The current spot rate is $0.60/SF.

a. Is the FI exposed to the dollar’s depreciating or appreciating relative to the SF? Why?

The FI is exposed to the dollar depreciating, because it would require more dollars to purchase the SF10 million if the loan is drawn down as expected.

b. If the spot rate six months from today is $0.64/SF, what amount of dollars is needed if the loan is taken down and the FI is unhedged?

The FI needs $0.64 x SF10 million = $6.4 million to make the SF-denominated loan.

c. If the FI decides to hedge using SF futures, should it buy or sell SF futures?

The FI should buy SF futures if it decides to hedge against the depreciation of the dollar.

d. A six-month SF futures contract is available for $0.61/SF. What net amount would be needed to fund the loan at the end of six months if the FI had hedged using the SF10 million futures contract? Assume that futures prices are equal to spot prices at the time of payment (i.e., at maturity).

If it has hedged using futures, the FI will gain ($0.64 - $0.61) x SF10 million = $300,000 on its futures position. Thus, the net payment will be $6.1 million.

36. A U.S. FI has assets denominated in Swiss francs (SF) of 75 million and liabilities of 125 million. The spot rate is $0.6667/SF, and one-year futures are available for $0.6579/SF.

a. What is the FI’s net exposure?

The net exposure is –SF50 million.

b. Is the FI exposed to dollar appreciation or depreciation relative to the SF?

The FI is exposed to depreciation of the dollar. If the dollar weakens, the FI will need to pay more dollars to cover its SF liabilities than it will receive for its assets.

c. If the SF spot rate changes from $0.6667/SF to $0.6897/SF, how will this impact the FI’s currency exposure? Assume no hedging.

The loss would be SF50,000,000($0.6667 - $0.6897) = -$1,150,000.

d. What is the number of futures contracts necessary to fully hedge the currency risk exposure of the FI? The contract size is SF125,000 per contract.

The number of contracts = SF50,000,000/SF125,000 = 400 contracts.

e. If the SF futures exchange rate falls from $0.6579/SF to $0.6349/SF, what will be the impact on the FI’s futures position?

The loss on the futures position would be 400 contracts x SF125,000 x ($0.6349 - $0.6579) =

-$1,150,000.

37. What is a credit forward? How is it structured?

A credit forward is a forward agreement that hedges against an increase in default risk on a loan. The credit forward specifies a credit spread on a benchmark bond issued by a bank borrower. The credit spread measures a risk premium above the risk free rate to compensate for default risk.

38. What is the gain on the purchase of a $20 million credit forward contract with a modified duration of seven years if the credit spread between a benchmark Treasury bond and a borrowing firm’s debt decreases by 50 basis points?

The gain would be (ΦT - ΦF) x MD x $20 million = 0.005 x 7 x $20 million = $700,000.

39. How is selling a credit forward similar to buying a put option?

After the loan is made, the FI sells a credit forward. If the credit risk of the borrower decreases sufficiently that the spread over the benchmark bond increases, the forward seller (the FI) will realize a gain at the maturity of the forward contract that will offset the decrease in value of the loan. Thus, the FI benefits as the credit risk of the borrower decreases. This is the exact same situation as a put option buyer when the stock price goes down.

If the credit risk improves, the lender FI will pay the forward buyer because the benchmark spread will have decreased. However, since the spread can only decrease to zero, the FI has limited loss exposure. This is similar to paying a premium on a put option.

40. A property-casualty (PC) insurance company has purchased catastrophe futures contracts to hedge against losses during the hurricane season. At the time of purchase, the market expected a loss ratio of 0.75. After processing claims from a severe hurricane, the PC actually incurred a loss ratio of 1.35. What amount of profit did the PC make on each $25,000 futures contract?

The payoff = actual loss ratio x $25,000 = 1.35 x $25,000 = $33,750.

41. What is the primary goal of regulators in regard to the use of futures by FIs? What guidelines have regulators given banks for trading in futures and forwards?

Regulators of banks have encouraged the use of futures for hedging and have discouraged the use of futures for speculation. Banks are required to (1) establish internal guidelines regarding hedging activity, (2) establish trading limits, and (3) disclose large contract positions that materially affect bank risk to shareholders and outside investors. Finally, FASB requires all firms to reflect the mark to market value of their derivative positions in their financial statements.

Because of their lack of regulation and because of the significant role that over-the-counter (OTC) derivative securities played in causing the financial crisis, in the summer of 2009 the Obama administration proposed a plan to regulate OTC derivatives. The plan, first, called for most of the OTC derivatives to trade on regulated exchanges which would guarantee trades and help cushion against potential defaults. This change makes it easier to see market prices of these securities and make the markets more transparent. Second, like exchanged traded derivatives, the previous OTC traded securities would now come under the authority of the SEC and the CFTC, while bank regulators would oversee banks that deal in derivatives. Thus, the changes result in OTC derivative securities being regulated to the same extent as exchange traded securities.

Integrated Mini Case: HEDGING INTEREST RATE RISK WITH FUTURES CONTRACTS

Use the following December 31, 2014 market value balance sheet for Bank One to answer the questions below.

**Assets (in thousands of $s) Liabilities/Equity (in thousands of $s)**

Value Duration Value Duration

T-bills $1,500 0.75 NOW accounts $ 6,250 0.50

T-bonds 4,250 9.50 CDs 7,500 7.55

Loans 15,500 12.50 Federal funds 5,500 0.10

Equity 2,000

## The bank’s manager thinks rates will increase by 0.50 percent in the next 3 months. To hedge this interest rate risk the manager will use June T-bond futures contracts. The T-bonds underlying the futures contracts have a maturity = 15 years, a duration = 14.25 years, and a price = 108-10 or $108,312.50. Assume that interest rate changes in the futures market relative to the cash market are such that br = 0.885.

1. Calculate the leverage adjusted duration gap (DGAP) for Bank One.

DA = [(1,500/21,250)(0.75) + (4,250/21,250)(9.50) + (15,500/21,250)(12.50)] = 11.07058824 years

DL = [(6,250/19,250)(0.50) + (7,500/19,250)(7.55) + (5,500/19,250)(0.10)] = 3.13246753 years

DGAP = 11.07058824 – (19,250/21,250)(3.13246753) = 8.2329 years

2. Using the DGAP model, if interest rates on assets and liabilities increase such that ΔRA/(1 + RA) = ΔRL/(1 +RL) = 0.0075, calculate the *change* in the value of assets and liabilities and the *new* value of the assets and liabilities for Bank One.

∆A = -11.07058824 x 21,250,000 x 0.0075 = -$1,764,375

=> New asset value = $21,250,000 -$1,764,375 = $19,485,625

∆L = -3.13246753 x 19,250,000 x 0.0075 = -$452,250

=> New liabilities value = $19,250,000 - $452,250 = $18,797,750

3. Calculate the change in the market value of equity for Bank One if rates increase such that ΔR/(1 +R) = 0.0075.

∆E = -8.2329 x 21,250,000 x 0.0075 = -$1,312,125

=> New equity value = $2,000,000 - $1,312,125 = $687,875

## 4. Calculate the correct number of futures contracts needed to hedge the bank’s interest rate risk (do not round to the nearest whole contract). Make sure you specify whether you should enter the hedge with a short or long futures position.



Since DGAP > 0, if interest rates increase, then MVE decreases. So, short futures contracts.

5. Calculate the change in the bank’s market value of equity and the change in the value of the T-bond futures position for the bank if interest rates increase by 0.55 percent from the current rate of 6 percent on the T-bonds and increase 0.65 percent from the current rate of 8 percent on the balance sheet assets and liabilities.

∆E = -8.2329 x 21,250,000 x (0.0065/1.08) = -$1,052,940

∆F = -14.25 x -128.0785 x 108,312.50 x (0.0055/1.06) = $1,025,717