Chapter 10

Forward and Futures Hedging, Spread, and Target Strategies

Chapter 10: Forward and Futures Hedging, Spread, and Target Strategies

The beauty of finance and speculation was that they could be different things to different men. To some: poetry or high drama; to others, physics, scientific and immutable; to still others, politics or philosophy. And to still others, war.

Michael M. Thomas

Hanover Place, 1990, p. 37

Important Concepts in Chapter 10

- Why firms hedge
- Hedging concepts
- Factors involved when constructing a hedge
- Hedge ratios
- Examples of foreign currency hedges, intermediate- and long-term interest rate hedges, and stock index futures hedges
- Examples of spread and target strategies

Why Hedge? (1 of 2)

- The value of the firm may not be independent of financial decisions because
  - Shareholders might be unaware of the firm's risks.
  - Shareholders might not be able to identify the correct number of futures contracts necessary to hedge.
  - Shareholders might have higher transaction costs of hedging than the firm.
  - There may be tax advantages to a firm hedging.
  - Hedging reduces bankruptcy costs.
- Managers may be reducing their own risk.
- Hedging may send a positive signal to creditors.
- Dealers hedge their market-making activities in derivatives.

Why Hedge? (2 of 2)

- Reasons not to hedge
  - Hedging can give a misleading impression of the amount of risk reduced
  - Hedging eliminates the opportunity to take advantage of favorable market conditions
  - There is no such thing as a hedge. Any hedge is an act of taking a position that an adverse market movement will occur. This, itself, is a form of speculation.

Hedging Concepts (1 of 10)

- Short Hedge and Long Hedge
  - Short (long) hedge implies a short (long) position in futures
  - Short hedges can occur because the hedger owns an asset and plans to sell it later.
  - Long hedges can occur because the hedger plans to purchase an asset later.
  - An anticipatory hedge is a hedge of a transaction that is expected to occur in the future.
  - See Table 10.1 on 34th slide for hedging situations.

Hedging Concepts (2 of 10)

- The Basis
  - Basis = spot price − futures price.
  - Hedging and the Basis
    - Π (short hedge) = $S_T - S_0$ (from spot market) − $(f_T - f_0)$ (from futures market)
    - Π (long hedge) = $-S_T + S_0$ (from spot market) + $(f_T - f_0)$ (from futures market)
    - If hedge is closed prior to expiration, Π (short hedge) = $S_t - S_0 - (f_t - f_0)$
    - If hedge is held to expiration, $S_t = S_T = f_T = f_t$.

Hedging Concepts (3 of 10)

- The Basis (continued)
  - Hedging and the Basis (continued)
    - Example: Buy asset for $100, sell futures for $103. Hold until expiration. Sell asset for $97, close futures at $97. Or deliver asset and receive $103. Make $3 for sure.
  - Basis definition
    - initial basis: $b_0 = S_0 - f_0$
    - basis at time t: $b_t = S_t - f_t$
    - basis at expiration: $b_T = S_T - f_T = 0$
  - For a position closed at t:
    - Π (short hedge) = $S_t - f_t - (S_0 - f_0) = -b_0 + b_t$

Hedging Concepts (4 of 10)

- The Basis (continued)
  - This is the change in the basis and illustrates the principle of basis risk.
  - Hedging attempts to lock in the future price of an asset today, which will be $f_0 + (S_t - f_t)$.
  - A perfect hedge is practically non-existent.
  - Short hedges benefit from a strengthening basis.
  - All of this reverses for a long hedge.
  - See Table 10.2 on 35th slide for hedging profitability and the basis.

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Hedging Concepts (5 of 10)

- The Basis (continued)
  - Example: March 30. Spot gold \$1,387.15. June futures \$1,388.60. Buy spot, sell futures. Note: b_0 = 1,387.15 − 1,388.60 = −1.45. If held to expiration, profit should be change in basis or 1.45.
    - At expiration, let S_T = \$1,408.50. Sell gold in spot for \$1,408.50, a profit of 21.35. Buy back futures at \$1,408.50, a profit of −19.90. Net gain =1.45 or \$145 on 100 oz. of gold.

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Hedging Concepts (6 of 10)

- The Basis (continued)
  - Example: (continued)
    - Instead, close out prior to expiration when S_t = \$1,377.52 and f_t = \$1,378.63.
    - Profit on spot = −9.63. Profit on futures = 9.97.
    - Net gain = 0.34 or \$34 on 100 oz.
    - Note that change in basis was $b_t - b_0$ or −1.11 − (−1.45) = 0.34.
  - Behavior of the basis, see Figure 10.1 on 36th slide.
  - In forward markets, the hedge is customized so there is no basis risk.

Hedging Concepts (7 of 10)

- Some Risks of Hedging
  - cross hedging
  - spot and futures prices occasionally move opposite
  - quantity risk

Hedging Concepts (8 of 10)

- Contract Choice
  - Which futures underlying asset?
    - High correlation with spot
    - Favorably priced
  - Which expiration?
    - The futures with maturity closest to but after the hedge termination date subject to the suggestion not to be in a contract in its expiration month
    - See Table 10.3 on 37th slide for example of recommended contracts for T-bond hedge
    - Concept of rolling the hedge forward

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Hedging Concepts (9 of 10)

- Contract Choice (continued)
  - Long or short?
    - A critical decision! No room for mistakes.
    - Three methods to answer the question. See Table 10.4 on 38th slide.
      - worst case scenario method
      - current spot position method
      - anticipated future spot transaction method

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Hedging Concepts (10 of 10)

- Margin Requirements and Marking to Market
  - low margin requirements on futures, but
  - cash will be required for margin calls

Determination of the Hedge Ratio (1 of 8)

- Hedge ratio: The number of futures contracts to hedge a particular exposure
  - Naïve hedge ratio
  - Appropriate hedge ratio should be
    - $N_f = -\Delta S/\Delta f$
    - Note that this ratio must be estimated.

Determination of the Hedge Ratio (2 of 8)

- Minimum Variance Hedge Ratio
  - Profit from short hedge:
    - $\Pi = \Delta S + \Delta f N_f$
  - Variance of profit from short hedge:
    - $\sigma_{\Pi}^2 = \sigma_{\Delta S}^2 + \sigma_{\Delta f}^2 N_f^2 + 2\sigma_{\Delta S \Delta f} N_f$
  - The optimal (variance minimizing) hedge ratio is
    - $N_f = -\sigma_{\Delta S \Delta f} / \sigma_{\Delta f}^2$
    - This is the beta from a regression of spot price change on futures price change.

Determination of the Hedge Ratio (3 of 8)

- Minimum Variance Hedge Ratio (continued)
  - Hedging effectiveness is
    - e^* = (risk of unhedged position − risk of hedged position)/risk of unhedged position
    - This is coefficient of determination from regression.

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Determination of the Hedge Ratio (4 of 8)

- Price Sensitivity Hedge Ratio
  - This applies to hedges of interest sensitive securities.
  - First we introduce the concept of duration. We start with a bond priced at B:

$$B = \sum_{t=1}^{T} \frac{CP_t}{(1+y_B)^t}$$

- where CP_t is the cash payment at time t and y_B is the yield, or discount rate.

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Determination of the Hedge Ratio (5 of 8)

- Price Sensitivity Hedge Ratio (continuation)
  - An approximation to the change in price for a yield change is

$$\Delta B = -B\frac{DUR_B(\Delta y)}{1+y_B}$$

  - with DUR_B being the bond's duration, which is a weighted-average of the times to each cash payment date on the bond, and Δ represents the change in the bond price or yield.
  - Duration has many weaknesses but is widely used as a measure of the sensitivity of a bond's price to its yield.
  - Modified duration (MD) measures the bond percentage price change for a given change in yield.

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Determination of the Hedge Ratio (6 of 8)

- Price Sensitivity Hedge Ratio (continuation)
  - The hedge ratio is as follows:

$$N_f^* = -\left(\frac{MD_B}{MD_f}\right)\left(\frac{B}{f}\right)$$

  - Where $MD_B \approx -(\Delta B / B) \;/\; \Delta y_B$ and $MD_f \approx -(\Delta f / f) \;/\; \Delta y_f$
  - Note the concepts of implied yield and implied duration of a futures. Also, technically, the hedge ratio will change continuously like an option's delta and, like delta, it will not capture the risk of large moves.

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Determination of the Hedge Ratio (7 of 8)

- Price Sensitivity Hedge Ratio (continuation)
  - Alternatively,
    - $N_f = -(\text{Yield beta})\text{PVBP}_B / \text{PVBP}_f$
      - where Yield beta is the beta from a regression of spot bond yield on futures yield and
      - PVBP_B, PVBP_f is the present value of a basis point change in the bond and futures prices.

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Determination of the Hedge Ratio (8 of 8)

- Stock Index Futures Hedging
  - Appropriate hedge ratio is
    - $N_f = -(\beta_S / \beta_f)(S / f)$
    - where β_S is the beta from the CAPM and β_f is the beta of the futures, often assumed to be 1.

Hedging Strategies (1 of 4)

- Long Hedge With Foreign Currency Futures
  - American firm planning to buy foreign inventory and will pay in foreign currency.
  - See Table 10.5 on 40th slide.
- Short Hedge With Foreign Currency Forwards
  - British subsidiary of American firm will convert pounds to dollars.
  - See Table 10.6 on 41st slide.

Hedging Strategies (2 of 4)

- Intermediate and Long-Term Interest Rate Hedges
  - First let us look at the CBOT T-note and bond contracts
    - T-bonds: must be a T-bond with at least 15 years to maturity or first call date
    - T-note: three contracts (2-, 5-, and 10-year)
    - A bond of any coupon can be delivered but the standard is a 6% coupon. Adjustments, explained in Chapter 9, are made to reflect other coupons.
    - Price is quoted in units and 32nds, relative to $100 par, e.g., 93 14/32 is $93.4375.
    - Contract size is $100,000 face value so price is $93,437.50

Hedging Strategies (3 of 4)

- Intermediate and Long-Term Interest Rate Hedges (continued)
  - Hedging a Long Position in a Government Bond
    - See Table 10.7 on 42nd slide for example.
  - Anticipatory Hedge of a Future Purchase of a Treasury Note
    - See Table 10.8 on 43rd slide for example.
  - Hedging a Corporate Bond Issue
    - See Table 10.9 on 44th slide for example.

Hedging Strategies (4 of 4)

- Stock Market Hedges
  - First look at the contracts
    - We primarily shall use the S&P 500 futures. Its price is determined by multiplying the quoted price by $250, e.g., if the futures is at 1300, the price is 1300($250) = $325,000
  - Stock Portfolio Hedge
    - See Table 10.10 on 45th slide for example.
  - Anticipatory Hedge of a Takeover
    - See Table 10.11 on 47th slide for example.

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Spread Strategies

- Intramarket Spreads
  - Based on changes in the difference in carry costs
  - See Figure 10.2 on 48th slide for illustration.
- Treasury Bond Futures Spreads
  - See Figure 10.3 on 49th slide and Figure 10.4 on 50th slide for illustration the relationship between changes in spreads and interest rates.
  - See Table 10.12 on 51st slide for calculation of Tbond futures spread profits.
- See Figure 10.5 on 52nd slide for illustration of stock index spreads

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Intermarket Spread Strategies

- Intermarket spread strategies involve two futures contracts on different underlying instruments
- Intermarket spread strategies tend to be more risky than intramarket spreads because there is both the change in spreads and the change in underlying instruments
- NOB denotes notes over bonds
- Intermarket spread strategies could also involve various equity markets

Target Strategies: Bonds

- Target Duration with Bond Futures
  - Number of futures needed to change modified duration

$$N_f^* = -\left(\frac{MD_T - MD_B}{MD_f}\right)\left(\frac{B}{f}\right)$$

  - Goal is to move the modified duration from its current value to a new target value
  - See Table 10.13 on 53^{rd} slide for illustration.

Target Strategies: Equities (1 of 2)

- Alpha Capture
  - Number of futures to hedge systematic risk

$$N_f^* = -\beta_S\left(\frac{S}{f}\right)$$

  - Goal is to move the eliminate systematic risk
  - See Table 10.14 on 54th slide for illustration.
- Target Beta (see Table 10.15 on 55th slide for illustration.)

$$N_f^* = -(\beta_T - \beta_S)\left(\frac{S}{f}\right)$$

Target Strategies: Equities (2 of 2)

- Tactical Asset Allocation
  - Strategic asset allocation – long run target weights for each asset class
  - Tactical asset allocation – short run deviations in weights for each asset class
  - See Table 10.16 on 57th slide for illustration.

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Summary

- Table 10.17 on 60th slide recaps the types of hedge situations, the nature of the risk and how to hedge the risk

TABLE 10.1: SUMMARY OF HEDGING SITUATIONS

CONDITION TODAY	RISK	APPROPRIATE HEDGE
Hold asset	Asset price may fall	Short hedge
Plan to buy asset	Asset price may rise	Long hedge
Sold short asset	Asset price may rise	Long hedge

Note: *Short hedge* means long spot, short futures; *long hedge* means short spot, long futures. Hedging situations involving loans are examined in Chapters 11 and 12.

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TABLE 10.2: HEDGING PROFITABILITY AND THE BASIS

TYPE OF HEDGE	BENEFITS FROM	WHICH OCCURS IF
Short hedge	Strengthening basis	Spot price rises more than futures price rises or Spot price falls less than futures price falls or Spot price rises and futures price falls
Long hedge	Weakening basis	Spot price rises less than futures price rises or Spot price falls more than futures price falls or Spot price falls and futures price rises

Note: *Short hedge* means long spot, short futures; *long hedge* means short spot, long futures.

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FIGURE 10.1: The September S&P 500 Index Basis

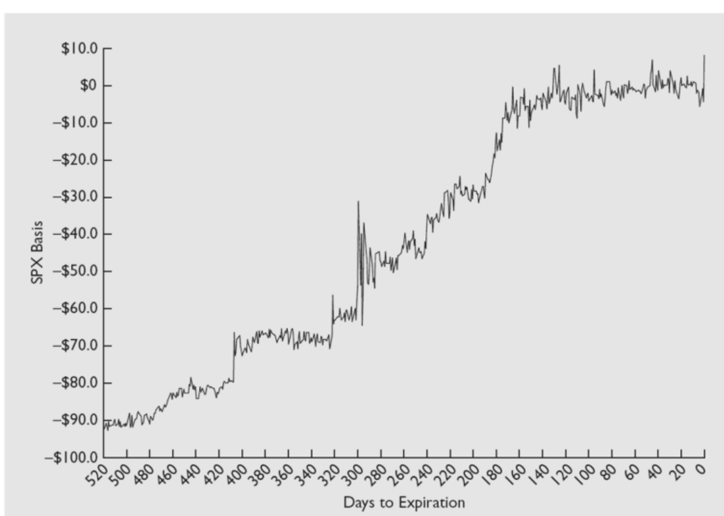

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TABLE 10.3: CONTRACT EXPIRATIONS FOR PLANNED HEDGE TERMINATION DATES (TREASURY BOND FUTURES HEDGE INITIATED ON SEPTEMBER 30, YY)

HEDGE TERMINATION DATE	APPROPRIATE CONTRACT
10/1/YY–11/30/YY	Dec YY
12/1/YY–2/28/YY+1	Mar YY+1
3/1/ YY+1–5/31/ YY+1	Jun YY+1
6/1/ YY+1–8/31/ YY+1	Sep YY+1
9/1/ YY+1–11/30/ YY+1	Dec YY+1
12/1/ YY+1–2/28/ YY+2	Mar YY+2
3/1/ YY+2–5/31/ YY+2	Jun YY+2
6/1/ YY+2–8/31/ YY+2	Sep YY+2
9/1/ YY+2–11/30/ YY+2	Dec YY+2

Note: The appropriate contract is based on the rule that the expiration date should be as soon as possible after the hedge termination date, subject to no contract being held in its expiration month. Liquidity considerations may make some more distant contracts inappropriate. YY denotes the current year, YY+1 denotes the next year, and YY+2 denotes two years from the current year.

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TABLE 10.4: HOW TO DETERMINE WHETHER TO BUY OR SELL FORWARDS/FUTURES WHEN HEDGING (1 of 2)

Worst-Case Scenario Method

1. Assuming that the spot and forward/futures markets move together, determine whether long and short positions in forward/futures will be profitable if the market goes up or down.
2. What is the worst that could happen in the spot market?
   a. The spot market goes up.
   b. The spot market goes down.
3. Given your answer in 2, assume that the worst that *can* happen *will* happen.
4. Given your answer in 3 and using your answer in 1, take a forward/futures position that will be profitable.

Current Spot Position Method

1. Determine whether your current position in the spot market is long or short.
   a. If you own an asset, your current position is long.
   b. If you are short an asset, your current position is short.
   c. If you are committed to buying an asset in the future, your current position is short.
2. Take a forward/futures position that is opposite the position given by your answer in 1.

(To Continue)

TABLE 10.4: HOW TO DETERMINE WHETHER TO BUY OR SELL FORWARDS/FUTURES WHEN HEDGING (2 of 2)

Anticipated Future Spot Transaction Method

1. Determine what type of spot transaction you will be making when the hedge is terminated.
   a. Sell an asset.
   b. Buy an asset.
2. Given your answer in 1, you will need to terminate a forward/futures position at the horizon date by doing the opposite transaction to the one in 1 (e.g., if your answer in 1 is “sell,” your answer here is “buy a forward/futures”).
3. Given your answer in 2, you will need to open a forward/futures contract today by doing the opposite (e.g., if your answer in 2 is “buy a forward/futures,” your answer here should be “sell a forward/futures”).

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TABLE 10.5: A LONG HEDGE WITH FOREIGN CURRENCY FUTURES

Scenario: On July 1, an American auto dealer enters into a contract to purchase 20 British sports cars with payment to be made in British pounds on November 1. Each car will cost £35,000. The dealer is concerned that the pound will strengthen over the next few months, causing the cars to cost more in dollars.

DATE	SPOT MARKET	FUTURES MARKET
July 1	The current exchange rate is \$1.3190 per pound. The forward rate of the pound is \$1.3060. Forward cost of 20 cars: 20(35,000)(\$1.3060) = \$914,200.	December pound contract is at \$1.278. Price per contract: 62,500(\$1.278) = \$79,875. The appropriate number of contracts is $\frac{20(35{,}000)}{62{,}500} = 11.2.$ **Buy 11 contracts**
November 1	The spot rate is \$1.442. Buy the £700,000 to purchase 20 cars. Cost in dollars: 700,000(\$1.442) = \$1,009,400.	December pound contract is at \$1.4375. Price per contract: 62,500(\$1.4375) = \$89,843.75. **Sell 11 contracts**

Analysis: The cars ended up costing \$1,009,400 − \$914,200 = \$95,200 more. The profit on the futures transaction is

$$\begin{array}{rl} 11(\$89{,}843.75) & \text{(sale price of futures)} \\ -11(\$79{,}875.00) & \text{(purchase price of futures)} \\ \hline \$109{,}656.25 & \text{(profit on future s)} \end{array}$$

The profit on the futures more than offsets the higher cost of the cars, leaving a net gain of \$109,656.25 − \$95,200 = \$14,456.25. The dealer effectively paid \$1,009,400 − \$109,656.25 = \$899,743.75 for the 20 cars.

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TABLE 10.6: A SHORT HEDGE WITH FOREIGN CURRENCY FORWARDS

Scenario: On June 29, a multinational firm with a British subsidiary decides it will need to transfer £10 million from an account in London to an account with a New York bank. Transfer will be made on September 28. The firm is concerned that over the next two months, the pound will weaken.

DATE	SPOT MARKET	FORWARD MARKET
June 29	The current exchange rate is $1.362 per pound. The forward rate of the pound is $1.357. Forward value of funds: 10,000,000($1.357) = $13,570,000.	Sell pounds forward for delivery on September 28 at $1.357.
September 28	The spot rate is $1.2375.	Deliver pounds and receive 10,000,000($1.357) = $13,570,000.

Analysis: The pounds end up worth $13,570,000 − $12,375,000 = $1,195,000 less but are delivered on the forward contract for $13,570,000, thus completely eliminating the risk. Had the transaction not been done, the firm would have converted the pounds at the spot rate of $1.2375.

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TABLE 10.7: HEDGING A LONG POSITION IN A GOVERNMENT BOND

Scenario: On February 25, a portfolio manager holds $1 million face value of a government bond, the 11 7/8s, which mature in about 25 years. The bond is currently priced at 101 and has a modified duration of 7.83. The manager will sell the bond on March 28 to generate cash to meet an obligation.

DATE	SPOT MARKET	FUTURES MARKET
February 25	The current price of the bonds is 101. Value of position: $1,010,000. The short end of the term structure is flat, so this is the forward price of the bonds in March.	June T-bond futures is at 70 16/32. Price per contract: $70,500. The futures price and the characteristics of the deliverable bond imply a modified duration of 7.20. Appropriate number of contracts: $N_f = -\left(\frac{7.83}{7.20}\right)\left(\frac{1,010,000}{70,500}\right) = -15.6$ **Sell 16 contracts**
March 28	The bonds are sold at the current price of 95 22/32. This is a price of $956.875 per bond. Value of position: $956,875.	June T-bond futures is at 66 23/32. Price per contract: $66,718.75. **Buy 16 contracts**

Analysis: When the $1 million face value bonds are sold on March 28, they are worth $956,875, a loss in value of $1,010,000 − $956,875 = $53,125.

The profit on the futures transaction is

$$\begin{array}{rl} 16(\$70{,}500) & \text{(sale price of futures)} \\ \underline{-16(\$66{,}718.75)} & \text{(purchase price of futures)} \\ \$60{,}500 & \text{(profit on futures)} \end{array}$$

Thus, the hedge eliminated the entire loss in value and resulted in an overall gain in value of $60,500 − $53,125 = $7,375.

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TABLE 10.8: ANTICIPATORY HEDGE OF A FUTURE PURCHASE OF A TREASURY NOTE

Scenario: On March 29, a portfolio manager determines that approximately $1 million will be available for investment on July 15. The manager plans to purchase the 11 5/8s Treasury notes maturing in about nine years, which have a modified duration of 5.6.

DATE	SPOT MARKET	FUTURES MARKET
March 29	The forward price of notes is 97 28/32. Current forward value of notes: $978,750. This implies a yield of 12.02 percent.	September T-note futures are at 78 21/32. Price per contract: $78,656.25. The futures price and the characteristics of the deliverable bond imply a modified duration of 6.2. Appropriate number of contracts: $N_f = -\left(\frac{\$978,750}{\$78,656.25}\right)\left(\frac{5.6}{6.2}\right) = 11.24.$ **Buy 11 contracts**
July 15	The notes are purchased at their current price of 107 19/32. This is a price of $1,075.9375 per note. Value of position: $1,075,937.50.	September T-note futures is at 86 6/32. Price per contract: $86,187.50. **Sell 11 contracts**

Analysis: When the $1 million face value notes are purchased on July 15, they cost $1,075,937.50, an increased cost of $1,075,937.50 − $978,750 = $97,187.50. The yield at this price is 10.31 percent.

The profit on the futures transaction is

$$
\begin{array}{rl}
11(\$86,187.50) & \text{(sale price of futures)} \\
\underline{-11(\$78,656.25)} & \text{(purchase price of futures)} \\
\$82,843.75 & \text{(profit on futures)}
\end{array}
$$

Thus, the hedge offset about 85 percent of the increased cost. The effective purchase price of the notes is $1,075,937.50 − $82,843.75 = $993,093.75, which is an effective yield of 11.75 percent.

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TABLE 10.9: HEDGING A CORPORATE BOND ISSUE

Scenario: On February 24, a corporation decides to issue $5 million of bonds on May 24. The firm currently has outstanding comparable bonds with a coupon of 9 3/8, a yield of 13.76 percent, and a maturity of about 21 years. The firm anticipates that if conditions do not change, the bonds when issued in May will be issued with a 13.76 percent coupon and be priced at par with a 20-year maturity and a modified duration of 7.22.

DATE	SPOT MARKET	FUTURES MARKET
February 24	If issued in May, it is expected that the bonds would offer a coupon of 13.76 percent and be priced at par with a modified duration of 7.22. Value of position: $5,000,000.	June T-bond futures are at 68 11/32. Price per contract: $68,343.75. The futures price and the characteristics of the deliverable bond imply a modified duration of 7.88 and a yield of 13.60 percent. Appropriate number of contracts: $N_f = -\left(\frac{7.22}{7.88}\right)\left(\frac{5,000,000}{68,343.75}\right) = -67.0.$ **Sell 67 contracts**
May 24	The yield on comparable bonds is 15.25 percent. The bonds are issued with a 13.76 percent coupon at a price of 90.74638. Price per bond: $907.46. Value of bonds: $4,537,319.	June T-bond futures is at 60 25/32. Price per contract: $60,781.25. **Buy 67 contracts**

$$
\begin{array}{rl}
67(\$68,343.75) & \text{(sale price of futures)} \\
\underline{-67(\$60,781.25)} & \text{(purchase price of futures)} \\
\$506,687.50 & \text{(profit on futures)}
\end{array}
$$

Analysis: When the $5 million face value bonds are issued on May 24, they are worth $4,537,319, a loss in value of $5,000,000 − $4,537,319 = $462,681. The yield at this price is 15.25 percent. (Note: Alternatively, if the bonds actually were issued at par with the coupon set at the yield on May 24 of 15.25 percent, the firm would receive the full $5,000,000 but the present value of its increased interest cost would be $462,681.)The profit on the futures transaction is

Thus, the hedge offset more than all the increased cost and left a net gain of $506,687.50 − $462,681 = $44,006.50. The effective issue price of the bonds is $4,537,319 + $506,687.50 = $5,044,006.50, which is an effective yield of 13.63 percent.

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TABLE 10.10: STOCK PORTFOLIO HEDGE (1 of 2)

Scenario: On March 31, a portfolio manager is concerned about the market over the next four months. The portfolio has accumulated an impressive profit, which the manager wants to protect over the period ending July 27 using the standard S&P 500 futures contract. The prices, number of shares, and betas are as follows.

STOCK	PRICE (3/31)	NUMBER OF SHARES	MARKET VALUE ($)	WEIGHT	BETA
Federal Mogul	18.875	18,000	339,750	0.044	1.00
Lockheed Martin	73.500	16,000	1,176,000	0.152	0.80
IBM	50.875	7,000	356,125	0.046	0.50
US West	43.625	10,800	471,150	0.061	0.70
Bausch & Lomb	54.250	21,000	1,139,250	0.148	1.10
First Union	47.750	28,800	1,375,200	0.178	1.10
Walt Disney	44.500	25,000	1,112,500	0.144	1.40
Tesoro	52.875	33,200	1,755,450	0.227	1.20
			7,725,425	1.000	

Portfolio beta:

0.044(1.00) + 0.152(0.80) + 0.046(0.50) + 0.061(0.70) + 0.147(1.10) + 0.178(1.10) + 0.144(1.40) + 0.227(1.20) = 1.06. S&P 500

September futures contract (assumed to have a beta of 1.0):

Price on March 31: 1,305

Multiplier: $250

Price of one contract: $250(1,305) = $326,250

Optimal number of futures contracts:

$$N_f = -1.06\left(\frac{7,725,425}{326,250}\right) = -25.10.$$

(To Continue)

TABLE 10.10: STOCK PORTFOLIO HEDGE (2 of 2)

SELL 25 CONTRACTS STOCK	PRICE (7/27)	MARKET VALUE ($)
Federal Mogul	21.625	389,250
Lockheed Martin	81.500	1,304,000
IBM	43.875	307,125
US West	47.125	508,950
Bausch & Lomb	45.875	963,375
First Union	48.125	1,386,000
Walt Disney	40.000	1,000,000
Tesoro	50.000	1,660,000
		7,518,700

Results: The values of the stocks on July 27 are as follows:

S&P 500 September futures contract:

Price on July 27: 1,295.40

Multiplier: $250

Price of one contract: $250(1,295.40) = $323,850

Buy 25 contracts

Analysis: The market value of the stocks declined by $7,725,425 − $7,518,700 = $206,725, a loss of 2.68 percent. The futures profit was

$$\begin{array}{rl} 25(\$326,250) & \text{(sale price of futures)} \\ \underline{-25(\$323,850)} & \text{(purchase price of futures)} \\ \$60,000 & \text{(profit on futures)} \end{array}$$

Thus, the overall loss on the stocks was effectively reduced to $206,725 − $60,000 = $146,725, a loss of 1.90 percent.

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TABLE 10.11: ANTICIPATORY HEDGE OF A TAKEOVER

Scenario: On July 15, a firm has decided to begin buying up shares of Felix Corporation with the ultimate objective of obtaining controlling interest. The acquisition will be made by purchasing lots of about 100,000 shares until sufficient control is obtained. The first purchase of 100,000 shares will take place on August 15. The stock is currently worth $26.50 and has a beta of 1.80.

DATE	SPOT MARKET	FUTURES MARKETS
July 15	Current price of the stock is 26.50. Current cost of shares: 100,000($26.50) = $2,650,000. The beta is 1.80.	September S&P 500 futures is at 1,260.50. Price per contract: $315,125. Approximate number of contracts: $N_f = -1.8\left(\frac{-2,650,000}{315,125}\right) = 15.14.$ Therefore, it should buy futures. **Buy 15 contracts**
August 15	The stock is purchased at its current price of 28.75. Cost of shares: 100,000($28.75) = $2,875,000.	September S&P 500 futures is at 1,327.20. Price per contract: $331,800. **Sell 15 contracts**

Analysis: When the 100,000 shares are purchased on August 15, they cost $2,875,000, an additional $225,000. The profit on the futures transaction is

15($331,800)	(sale price of futures)
−15($315,125)	(purchase price of futures)
$250,125	(profit on futures)

Thus, the hedge eliminated all the additional cost and left a small gain. The shares end up effectively costing ($2,875,000 − $250,125)/100,000 = $26.25.

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FIGURE 10.2: Changes in Spread Based on Carry Costs Changes

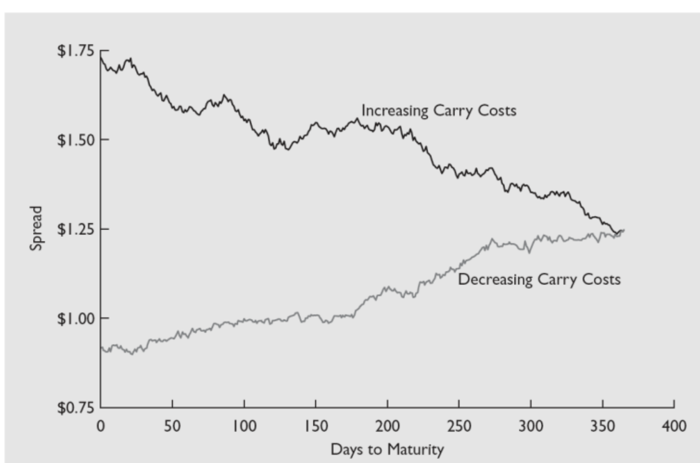

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FIGURE 10.3: Changes in Spread U.S. Treasury Bond Futures Contracts

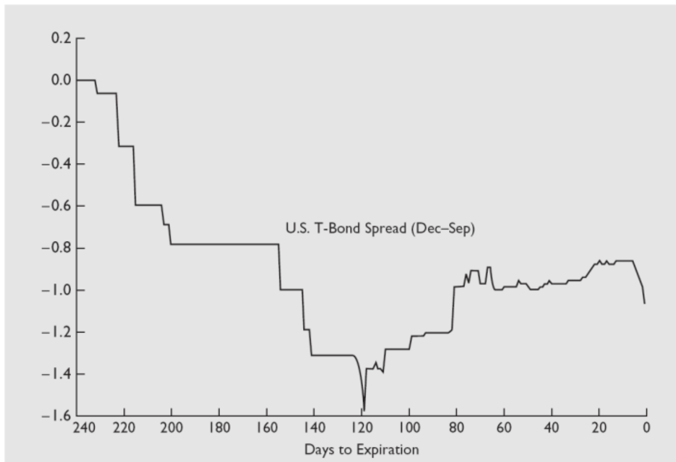

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FIGURE 10.4: Short-Term LIBOR Interest Rates

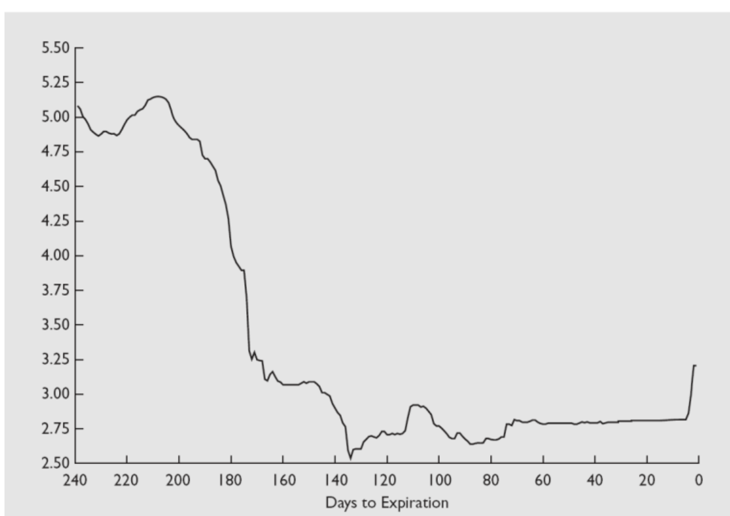

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TABLE 10.12: A TREASURY BOND FUTURES SPREAD

Scenario: It is July 6. Interest rates have steadily risen over the last six months. The yield on long-term government bonds is 13.54 percent. A Treasury bond futures floor trader anticipates that rates will continue upward; however, the economy remains healthy, and there are no indications that the Fed will tighten the money supply, which would drive rates further upward. Thus, although the trader is bearish, she is encouraged by other economic factors. She wants to take a speculative short position in T-bond futures but is concerned that rates will fall, generating a potentially large loss. She believes that if rates have not changed by late August, they will not change at all. Thus, she shorts the September contract and buys the December contract.

DATE	FUTURES MARKET
July 6	The September T-bond futures price is 60 22/32, or 60.6875. Price per contract: \$60,687.50. **Sell 1 contract** The December T-bond futures price is 60 2/32, or 60.0625. Price per contract: \$60,062.50. **Buy 1 contract**
August 31	The September T-bond futures price is 65 27/32, or 65.84375. Price per contract: \$65,843.75. **Buy 1 contract** The December T-bond futures price is 65 5/32, or 65.15625. Price per contract: \$65,156.25. **Sell 1 contract**

Analysis: The profit on the September contract was \$60,687.50 − \$65,843.75 = −\$5,156.25.
The profit on the December contract was \$65,156.25 − \$60,062.50 = \$5,093.75.
Thus, the overall profit was −\$5,156.25 + \$5,093.75 = −\$62.50.

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FIGURE 10.5: S&P 500 Index Futures Spread and Short-Term Interest Rates

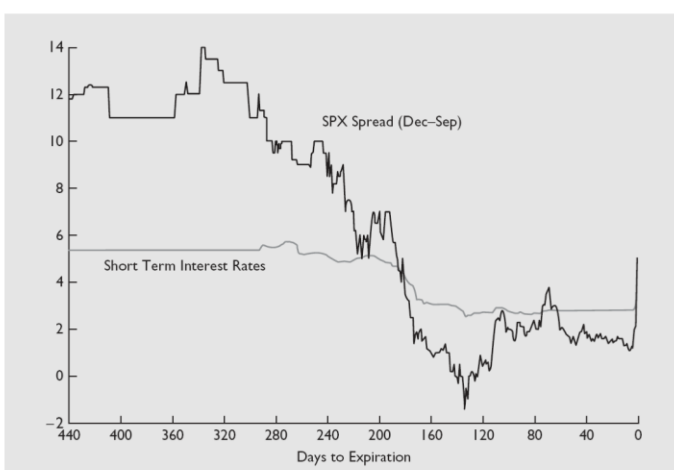

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TABLE 10.13: TARGET DURATION WITH BOND FUTURES

Scenario: On February 25, a portfolio manager holds $1 million face value of a government bond, the 11 7/8s, which matures in about 25 years. The bond is currently priced at 101, has a modified duration of 7.83, and has a yield of 11.74 percent. The manager plans to sell the bond on March 28. The manager is worried about rising interest rates and would like to reduce the bond's sensitivity to interest rates by lowering its modified duration to 4. This would reduce its interest sensitivity, which would help if rates increase, but would not eliminate the possibility of gains from falling rates.

DATE	SPOT MARKET	FUTURES MARKET
February 25	The current price of the bonds is 101. Value of position: $1,010,000. The short end of the term structure is flat, so this is the forward sale price of the bonds in March.	June T-bond futures is at 70 16/32. Price per contract: $70,500. The futures price and the characteristics of the deliverable bond imply a modified duration of 7.20 and a yield of 14.92 percent. Appropriate number of contracts: $N_f = -\left(\frac{4 - 7.83}{7.20}\right)\left(\frac{1{,}010{,}000}{70{,}500}\right) = -7.62.$ **Sell 8 contracts**
March 28	The bonds are sold at their current price of 95 22/32. This is a price of $956.875 per bond. Value of position: $956,875.	June T-bond futures is at 66 23/32. Price per contract: $66,718.75. **Buy 8 contracts**

Analysis: When the $1 million face value bonds are sold on March 28, they are worth $956,875, a loss in value of $1,010,000 − $956,875 = $53,125.

The profit on the futures transaction is

$$\begin{array}{rl} 8(\$70{,}500) & \text{(sale price of futures)} \\ -8(\$66{,}718.75) & \text{(purchase price of futures)} \\ \hline \$30{,}250 & \text{(profit on futures)} \end{array}$$

Thus, the overall transaction resulted in a loss in value of $53,125 − $30,250 = $22,875, which is a 2.26 percent decline in overall value.

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TABLE 10.14: ALPHA CAPTURE

Scenario: On July 1, you are following the stock of Helene Curtis, which has a price of 17.38 and a beta of 1.10. Barring any change in the general level of stock prices, you expect the stock to appreciate by about 10 percent by the end of September. Your analysis of the market as a whole calls for about an 8 percent decline in stock prices in general over the same period. Because the stock has a beta of 1.10, this would bring the stock down by 1.10(.08) = 0.088, or 8.8 percent, which will almost completely offset the expected 10 percent unsystematic increase in the stock price. You decide to hedge the market effect by selling a particular stock index futures contract with a multiplier of 500.

DATE	SPOT MARKET	FUTURES MARKET
July 1	Own 150,000 shares of Helene Curtis stock at 17.38. Value of stock: 150,000($17.38) = $2,607,000.	December stock index futures price is 444.60. Price of one contract: 444.60($500) = $222,300. Appropriate number of contracts $N_f = -1.10\left(\frac{\$2{,}607{,}000}{\$222{,}300}\right) = -12.90.$ **Sell 13 contracts**
September 30	Stock price is 17.75. Value of stock: 150,000($17.75) = $2,662,500.	December stock index futures price is 411.30. Price of one contract: 411.30($500) = $205,650. **Buy 13 contracts**

Analysis

Profit on stock:

$$\begin{array}{r} \$2{,}662{,}500 \\ -\$2{,}607{,}000 \\ \hline \$\quad 55{,}500 \end{array}$$

Profit on futures:

$$\begin{array}{r} 13(\$222{,}300) \\ -13(\$205{,}650) \\ \hline \$216{,}450 \end{array}$$

Overall profit:

$$\begin{array}{r} \$55{,}500 \\ +\$216{,}450 \\ \hline \$271{,}950 \end{array}$$

Overall rate of return:

$$\frac{\$271{,}950}{\$2{,}607{,}300} = 0.1043$$

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TABLE 10.15: TARGET BETA STRATEGIES WITH STOCK INDEX FUTURES (1 of 2)

Scenario: On August 29, a portfolio manager is holding a portfolio of stocks worth $3,783,210. The portfolio beta is 0.95. The manager expects the stock market as a whole to appreciate substantially over the next three months and wants to increase the portfolio beta to 1.25. The manager could buy and sell shares in the portfolio, but this would incur high transaction costs and later the portfolio beta would have to be adjusted back to 0.95. The manager decides to buy stock index futures to temporarily increase the portfolio's systematic risk. The prices, number of shares, and betas are the following. The target date for evaluating the portfolio is November 29.

STOCK	PRICE (8/29)	NUMBER OF SHARES	MARKET VALUE ($)	WEIGHT	BETA
Beneficial Corp.	40.50	11,350	459,675	0.122	0.95
Cummins Engine	64.50	10,950	706,275	0.187	1.10
Gillette	62.00	12,400	768,800	0.203	0.85
Kmart	33.00	5,500	181,500	0.048	1.15
Boeing	49.00	4,600	225,400	0.059	1.15
W. R. Grace	42.62	6,750	287,685	0.076	1.00
Eli Lilly	87.38	11,400	996,132	0.263	0.85
Parker Pen	20.62	7,650	157,743	0.042	0.75
			3,783,210	1.000	

Portfolio beta:
0.122(0.95) + 0.187(1.10) + 0.203(0.85) + 0.048(1.15) + 0.059(1.15) + 0.076ð1.00) + 0.263(0.85) + 0.042(0.75) = 0.95.
December stock index futures contract:
Price on August 29: 759.60
Multiplier: $250
Price of one contract: $250(759.60) = $189,900
Required number of futures contracts:

$$N_f = (1.25 - 0.95)\left(\frac{3,783,210}{189,900}\right) = 5.98.$$

Buy 6 contracts
Results: The values of the stocks on November 29 are the following.

(To Continue)

TABLE 10.15: TARGET BETA STRATEGIES WITH STOCK INDEX FUTURES (2 of 2)

SELL 25 CONTRACTS STOCK	PRICE (11/29)	MARKET VALUE ($)
Beneficial Corp.	45.13	512,226
Cummins Engine	66.75	730,913
Gillette	69.87	866,388
Kmart	35.12	193,160
Boeing	49.12	225,952
W. R. Grace	40.75	275,062
Eli Lilly	103.75	1,182,750
Parker Pen	22.88	175,032
		4,161,483

December stock index futures contract:
Price on November 29: 809.60
Multiplier: $250
Price of one contract: $250(809.60) = $202,400
Sell 6 contracts
Analysis: The market value of the stocks increased by $4,161,483 − 3,783,210 = $378,273, a gain of about 10 percent. The futures profit was

$$\begin{array}{rl} 6(\$202,400) & \text{(sale price of futures)} \\ \underline{-6(\$189,900)} & \text{(purchase price of futures)} \\ \$75,000 & \text{(profit on futures)} \end{array}$$

Thus, the overall gain on the portfolio was effectively increased to $378,273 + $75,000 = $453,273, a return of about 12 percent.

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TABLE 10.16: TACTICAL ASSET ALLOCATION USING STOCK AND BOND FUTURES (1 of 3)

Scenario: A $30 million portfolio consists of $20 million of stock at a beta of 1.15 and $10 million of bonds at a modified duration of 6.25 with a yield of 7.15 percent. The manager would like to change the allocation to $15 million of stock and $15 million of bonds. In addition, the manager would like to adjust the beta on the stock to 1.05 and the modified duration on the bonds to 7. A stock index futures contract has a price of $225,000, and we can assume that its beta is 1.0. A bond futures contract is priced at $92,000 with an implied modified duration of 5.9 and an implied yield of 5.65 percent. The manager will use futures to synthetically sell $5 million of stock, reduce the beta on the remaining stock, synthetically buy $5 million of bonds, and increase the modified duration on the remaining bonds. The horizon date is three months.

Step 1. Synthetically sell $5 million of stock

This transaction will effectively reduce the beta on $5 million of stock to zero, thereby synthetically converting the stock to cash. The number of stock futures, which we denote as N_{sf} , will be

$$N_{sf} = (0 - 1.15)\left(\frac{5{,}000{,}000}{225{,}000}\right) = -25.56.$$

This rounds off to selling 26 contracts. After executing this transaction, the portfolio effectively consists of $15 million of stock at a beta of 1.15, $10 million of bonds at a modified duration of 6.25, and $5 million of synthetic cash. Of course, the actual portfolio consists of $20 million of stock at a beta of 1.15, $10 million of bonds at a modified duration of 6.25, and $5 million of short stock index futures.

(To Continue)

TABLE 10.16: TACTICAL ASSET ALLOCATION USING STOCK AND BOND FUTURES (2 of 3)

Step 2. Synthetically buy $5 million of bonds

This transaction will effectively convert the $5 million of synthetic cash, which can be treated as a bond with a modified duration of zero, to $5 million of synthetic bonds with a modified duration of 6.25. The number of bond futures, which we denote as N_{bf} , will be

$$N_{bf} = \left(\frac{6.25 - 0}{5.9}\right)\left(\frac{5{,}000{,}000}{92{,}000}\right) = 56.6.$$

This rounds off to buying 57 contracts. After executing this transaction, the portfolio effectively consists of $15 million of stock at a beta of 1.15 and $15 million of bonds at a modified duration of 6.25. Of course, the actual portfolio consists of $20 million of stock at a beta of 1.15, $10 million of bonds at a modified duration of 6.25, $5 million of short stock index futures, and $5 million of long bond futures.

Step 3. Lower the beta on the stock from 1.15 to 1.05

Now the manager wants to lower the beta from 1.15 to 1.05 on $15 million of stock. This will require

$$N_{sf} = (1.05 - 1.15)\left(\frac{15{,}000{,}000}{225{,}000}\right) = -6.67.$$

contracts. Rounding off, the manager would sell 7 contracts. In the aggregate, the manager would sell 33 stock index futures contracts.

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TABLE 10.16: TACTICAL ASSET ALLOCATION USING STOCK AND BOND FUTURES (3 of 3)

Step 4. Raise the modified duration on the bonds from 6.25 to 7

Now the manager wants to raise the modified duration from 6.25 to 7 on $15 million of bonds. This will require

$$N_{bf} = \left(\frac{7 - 6.25}{5.9}\right)\left(\frac{15{,}000{,}000}{92{,}000}\right) = 20.73$$

contracts. Rounding off, the manager would buy 21 contracts. In the aggregate, the manager would buy 78 bond futures contracts. It is important to know that the same results would be obtained if the transactions were carried out in a different order. The manager could first reduce the beta on the $20 million of stock and then synthetically sell $5 million of stock. The manager could then increase the modified duration on the $10 million of bonds and then synthetically buy $5 million of bonds.

Results

Three months later the stock is worth $19,300,000 and the bonds are worth $10,100,000. The stock index futures price falls to $217,800, and the bond futures price rises to $92,878. The profit on the stock index futures transaction is −33($217,800 − $225,000) = $237,600.

The profit on the bond futures transaction is

78($92,878 − $92,000) = $68,484.

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TABLE 10.17: HEDGE SITUATIONS

THE SCENARIO	THE RISK	THE APPROPRIATE ACTION
Plan to purchase a foreign currency with domestic currency.	The foreign currency will increase in value.	Buy forwards or futures.
Plan to convert a foreign currency into domestic currency.	The foreign currency will decrease in value.	Sell forwards or futures.
Hold a bond or bond portfolio.	Interest rates will increase, decreasing the value of the bond.	Sell futures on notes or bonds.
Plan to purchase a bond.	Interest rates will decrease, increasing the value of the bond.	Buy futures on notes or bonds.
Plan to issue a bond.	Interest rates will increase, decreasing the value of the bond.	Sell futures on notes or bonds.
Hold stock portfolio.	Stock prices will fall, decreasing the value of the portfolio.	Sell stock index futures.
Plan to purchase a stock.	Stock prices will increase, increasing the cost to purchase.	Buy stock index futures.
Expect changes in futures prices with the same underlying.	Futures prices fail to comply with expectations.	Intramarket spread.
Expect changes in futures prices with different underlying.	Futures prices fail to comply with expectations.	Intermarket spread.
Alter interest rate risk of bond portfolio.	Interest rates move in unexpected way.	Target duration.
Capture excess return within an actively managed portfolio.	Active management fails to generate excess returns.	Alpha capture.
Alter equity risk of stock portfolio.	Stock prices move in unexpected way.	Target beta.
Alter both interest rate risk and equity risk in portfolio.	Rates and prices move in unexpected ways.	Tactical asset allocation.

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