Chapter 16
Futures Contracts

Concept Questions

1.  a. Three are visible in Figure 16.1; wheat futures are traded on the Chicago Board of Trade (CBT), Kansas City Board of Trade (KC), and Minneapolis Grain Exchange (MPLS). There are two others, the Winnipeg Commodity Exchange (WPG) and the MidAmerica Commodity Exchange (MCE), not shown in Figure 16.1. Of these, the largest trading activity occurs in Chicago.
   
   b. There are 100 troy oz. per contract, for a total of 1,000 troy oz. on ten contracts. It is traded on the COMEX division of the New York Mercantile Exchange.
   
   c. At 5,000 bu. per contract, you must deliver 100,000 bushels.
   
   d. The April contract has the largest open interest and the October contract has the smallest open interest.

2. Long hedge; i.e., buy corn futures. If corn prices do rise, then the futures position will show a profit, offsetting the losses from higher corn prices when they are purchased.

3. Short the index futures. If the S&P 500 index subsequently declines in a market sell-off, the futures position will show a profit, offsetting the losses on the portfolio of stocks.

4. Sell the futures. If interest rates rise, causing the value of the bonds to be less at the time of sale, the corresponding futures hedge will show a profit.

5. Buy yen futures. If the value of the dollar depreciates relative to the yen in the intervening four months, then the dollar/yen exchange rate will rise, and the payment required by the importer in dollars will rise. A long yen futures position would profit from the dollar’s depreciation and offset the importer’s higher invoice cost.

6. Sell crude oil futures. Price declines in the oil market would be offset by a gain on the short position.

7. Sell T-bond futures. Bond price declines in the market would be offset by a gain on the short position.

8. It is true. Each contract has a buyer and a seller, a long and a short. One side can only profit at the expense of the other. Including commissions, futures contracts, like most derivative assets, are actually negative sum gains. This doesn’t make them inappropriate tools, it just means that, on average and before commissions, they are a break-even proposition.
9. In reality, two factors make stock index arbitrage more difficult than it might appear. First, the dividend yield on the index depends on the dividends that will be paid over the life of the contract; this is not known with complete certainty and must, therefore, be estimated. Second, buying or selling the entire index is feasible, but index staleness (discussed in our first stock market chapter) is an issue; the current up-to-the-second price of the index is not known because not all components will have just traded. Of course, trading costs must be considered as well.

Thus, there is some risk in that the inputs used to determine the correct futures price may be incorrect, and what appears to be a profitable trade may not be. Program traders usually establish bounds, meaning that no trade is undertaken unless a deviation from parity exceeds a preset amount. Setting the bounds is itself an issue. If they are set too narrow, then the risks described above exist. If they are set too wide, other traders will step in sooner and eliminate the profit opportunity.

10. There are two similarities. 1) You are selling an asset today that you do not currently own (you may expect to own the asset in the future, say a wheat harvest). 2) Both contracts have an initial margin and a maintenance margin. There are several major differences between a futures contract and short selling a stock. 1) With a futures contract you are agreeing to a price at a specific date in the future. The price at settlement may be above or below the agreed upon price. In short selling the stock, you are selling at the current price and the price in the future is not set. 2) In a futures contract, the maturity date is determined when the contract is sold. A short stock sale can theoretically extend to infinity. 3) The cash flows from the short sale are different. In a futures contract, cash for the sale of a futures contract is not exchanged until the settlement of the contract. At the settlement date, you will receive the cash for the sale. In a short stock sale, you receive the cash for the sale of the stock today (although your broker may not allow you access to the cash). When you close the short stock position, you must pay cash to purchase the stock.

**Core Questions**

1. a. The settle price is 240.75 cents per bushel. One contract is valued as the contract size times the per unit price, so 5,000 × $2.4075 = $12,037.50.
   b. The settle price is 113:08, or 113.250% of par value. The value of a position in 10 contracts is 10 × $100,000 × 1.13250 = $1,132,500.
   c. The index futures price was down 1.25 for the day, or $500 × 1.25 = $625. For a position in 25 contracts, this represents a change in value of 25 × 625 = $15,625, which would represent a loss to a long position in the futures contract and a profit to a short position in the futures contract.
   d. The contract price closed up .36 cents for the day, so a short position would have had a loss of 10 × 60,000 × $0.0036 = $216,000.

2. The contract settled up 4.00 cents, so a long position gains: 20 × 5,000 × $0.0400 = $4,000.00.

3. The contract settled up 3.75 cents, so a short position loses: 15 × 5,000 × $0.0375 = $2,812.50.

4. The contract settled up 15.5 points, so a short position loses: 30 × $100,000 × (15.5/32)% = $14,531.25.
5. The total open interest on the Japanese Yen mark is 99,924 contracts. This is the number of contracts. Each contract has a long and a short, so the open interest represents either the number of long positions or the number of short positions. Each contract calls for the delivery of ¥12,500,000, and the settle price on the June contract is $.008613 per yen, or $.8613 × ¥12,500,000 = $107,662.50. With 99,924 contracts, the total dollar value is about $10.8 billion.

6. \( F_5 = 52.30(1 + .05)\frac{5}{12} = 53.37 \)

7. \$93.25 = S(1 + .045)^{3/12}; S = $92.23

8. \$50.29 = 48.73(1 + R)^{4/12}; R = .0484

9. \( F_4 = 98.25(1 + .054 - .025)\frac{4}{12} = 99.19 \)

10. \$84.21 = S(1 + .061 - .020)^{6/12}; S = $82.54

Intermediate Questions

11. If the contract settles down, a long position loses money. The loss per contract is: \( 42,000 \times .01 = $420 \), so when the account is marked-to-market and settled at the end of the trading day, your balance is $1,080, which is less than the maintenance margin. The minimum price change for a margin call is $250 = 42,000 \times X\), or \( X = .00595 = 0.595 \) cents per gallon.

12. Establish your account at an initial margin of 10 \times $1,000 = $10,000. Your maintenance margin is 10 \times $750 = $7,500. The initial value of the position is 10 \times 100 \times $355 = $355,000.

   Day 1: New position value = 10 \times 100 \times $351 = $351,000, for a loss of $4,000. Your margin account balance is now $6,000. You must meet a margin call of $4,000, bringing your margin back to $10,000

   Day 2: New position value = 10 \times 100 \times $354 = $354,000, for gain of $3,000. Your margin account balance is now $13,000.

   Day 3: New position value = 10 \times 100 \times $358 = $358,000, for a gain of $4,000. Your margin account balance is now $17,000.

   Day 4: New position value = 10 \times 100 \times $360 = $360,000, for a gain of $2,000. Your margin account balance is now $19,000.

   Your total profit is $360,000 – 355,000 = $5,000.
13. Establish your account at an initial margin of $25 \times 1,600 = $40,000. Your maintenance margin is $25 \times 1,200 = $30,000. The initial value of the position is $25 \times 42,000 \times 0.712 = $747,600.

Day 1: New position value = $25 \times 42,000 \times 0.734 = $770,700, for a loss of $23,100. Your margin account balance is now $16,900, so you face a margin call. Put another $23,100 into your account to bring it up to the required margin.

Day 2: New position value = $25 \times 42,000 \times 0.719 = $754,950, for a gain of $15,750. Your margin account balance is now $55,750.

Day 3: New position value = $25 \times 42,000 \times 0.709 = $744,450, for a gain of $10,500. Your margin account balance is now $66,250.

Day 4: New position value = $25 \times 42,000 \times 0.710 = $745,500, for a loss of $1,050. Your margin account balance is now $65,200.

Your total profit is $747,600 – 745,500 = $2,100

14. $20 \times 1,000 \times (23.82 – 25.10) = –$25,600

15. $-15 \times 62,500 \times (1.5934 – 1.6416) = $45,187.50

16. Parity implies that $F = 1,800(1 + .07 – .02)^{1/2} = 1,844.45$. Thus, if the futures price is actually at 1,860, the futures are overpriced, and you would want to buy the index and sell the futures.

17. Number of contracts = $(1.2 \times 300,000,000) / (445 \times 500) = 1,617.98$ or about 1,618 contracts. However, the Midcap 400 futures might not be liquid enough to handle such a large hedge. Also, when the contract expires it will be necessary to “roll” the hedge into a subsequent contract month.

18. $1,046.70 = 1,030.220(1 + X)^{6/12}; X = .0322$

19. $1,041.25 = 1,020.50(1 + .07 – d)^{1/2}; d = .0289$

20. $D_F = 9 + (3/12) = 9.25$ years
Contracts to sell = $(6.5 \times 900,000,000) / (9.25 \times 1.02 \times 100,000) = 6,200.32$ or about 6,200 contracts.

21. $D_F = 8 + (70/365) = 8.19$ years
Contracts to sell = $(14.5 \times 400,000,000) / (8.19 \times 0.98 \times 100,000) = 7,224.76$ or about 7,225 contracts.
22. \( F = $64.26(1 + .04)^{5/12} = $65.32; \) the futures is overpriced

\[ \text{b. Opening transactions now:} \]
- Sell the futures: \( $0 \)
- Buy the stock: \(-$64.26\)
- Borrow $64.26 at 4% for 5 months: \(+$64.26\)
- Total cash flow: \( $0.00 \)

\[ \text{Closing transactions:} \]
- Deliver the futures: \(+$66.02\)
- Sell the stock: \( $0 \)
- Repay the loan with interest: \(-$65.32\)
- Total cash flow: \( $0.70 \)

23. \( F = $64.26(1 + .04)^{5/12} = $65.32; \) the futures is overpriced

\[ \text{b. Opening transactions now:} \]
- Buy the futures: \( $0 \)
- Sell the stock short: \(+$80.34\)
- Lend $80.34 at 7% for 6 months: \(-$80.34\)
- Total cash flow: \( $0.00 \)

\[ \text{Closing transactions:} \]
- Accept delivery on the futures: \(-$81.76\)
- Sell the stock: \( $0 \)
- Collect on the loan: \(+$83.10\)
- Total cash flow: \( $0.34 \)

24. AIMR suggested answers:

\[ \text{a. The arbitrage strategy that would take advantage of the arbitrage opportunity is a Reverse Cash and Carry. A Reverse Cash and Carry opportunity results from the following relationship not holding true:} \]

\[ F_{0,t} \geq S_0 (1 + C) \]

If the futures price is less than the spot price plus the cost of carrying the goods to the futures delivery date, and arbitrage in the form of a Reverse Cash and Carry exists. A trader would be able to sell the asset short, use the proceeds to lend at the prevailing interest rate, and buy the asset for future delivery. At the future delivery, the trader would then collect the proceeds from the loan with interest, accept delivery of the asset, and cover the short position with the commodity.

\[ \text{b. Opening transactions now:} \]
- Sell the commodity short: \(+$120.00\)
- Buy the commodity futures expiring in 1 year: \( 0.00 \)
- Contract to lend $120 at 8% for 1 year: \(-$120.00\)
- Total cash flow: \( $0.00 \)

\[ \text{Closing transactions one year from now:} \]
- Accept delivery on expiring futures: \(-$125.00\)
- Cover the short commodity position: \( 0.00 \)
- Collect on loan of $120: \(+$129.60\)
- Total cash flow: \( $4.60 \)
c. **Direct Transaction Costs:** First, the trader must pay a fee to have an order executed. This fee includes commissions and various exchange fees. Second, in every market, there is a bid-ask spread. Market makers on the floor of the exchange must try to sell at a higher price (ask price) than the price at which they are willing to buy (bid price). Without the inclusion of transactions costs, the same arbitrage opportunity that is profitable without transaction costs may not be profitable after transaction costs. Rather than having a specific no-arbitrage price in which traders can profit, there is now a bond of no-arbitrage futures prices, bounded by the applicable transaction costs.

**Unequal Borrowing and Lending Rates:** In perfect markets, all traders can borrow and lend at the risk-free rate. This is not true in real markets. Generally, traders face a borrowing rate that exceeds the lending rate. As in the case of transaction costs, there is no longer a single no-arbitrage price but rather a transaction that has boundaries established by the differential between the borrowing and lending rates.

**Restrictions on Short Selling:** In perfect markets traders can sell assets short and use the proceeds from the short sale. In actual markets, however, there are serious impediments to short selling. First, for some goods, there is virtually no opportunity for short selling. This is particularly true for many physical goods. Second, even when short selling is permitted, restrictions limit the use of funds from the short sale. Often these restrictions mean that the short seller does not have the use of all of the proceeds from the short sale. This particularly is important in the reverse cash and carry, where the short sale is employed in the transaction. Short selling restrictions lower the boundary of the reverse cash and carry. If an investor can only use a portion of the short sale proceeds, that condition will depress the lower boundary, having little effect on the futures price.

**Limitations on Storage:** The storability of a commodity is important in the futures pricing of some commodities. While some goods store well, others do not. Perishable commodities are said to have infinite storage costs. This limitation to storage means that a cash and carry strategy cannot link futures and cash prices. Therefore, when the cash and carry or reverse cash and carry strategy are executed, the inability to store a commodity indefinitely can cause the no arbitrage bounds to be altered to reflect the actual limitations to storage.

**Supply Shortage:** The supply of commodities such as gold is large relative to its consumption, hence the market for gold will closely approximate its full carry market. The supply of some industrial metals is small relative to consumption and those markets are not full carry markets.

**Seasonal Factors:** Highly seasonal production or consumption factors can cause distortions in normal price relationships.

Tam must also realize that these imperfections differ widely across markets and have different effects on different traders, and that their potential effect on her ability to implement a given arbitrage strategy depends on her unique circumstances.
25. AIMR suggested answers:

a. According to the cost-of-carry rule, the futures price must equal the spot price plus the cost of carrying the spot commodity forward to the delivery date of the futures contract.

\[ F_{0.6} = 185.00 \times (1 + \frac{.06}{2}) = 190.55 \]

b. Assuming that the only carrying charge is the financing cost at an interest rate of 6.00 percent, the lower bound imposed by the reverse cash-and-carry strategy including transaction costs is:

Cash inflows:
- Buy 1 contract of TOBEC stock index futures (December contract)
- Sell the index spot at 185.00 \times $100 = $18,500
- Invest the proceeds at the risk-free rate for six months (until the expiration of the contract)
\[ $18,500 \times (1 + \frac{.06}{2}) = $19,055 \]

Six months from now:
At expiration the futures price is assumed to converge to the spot price, and
- Sell 1 contract of the TOBEC stock index futures (December contract)
- Buy the index spot
- Collect on the investment ($19,055)
- Pay transaction costs = $15.00
Total = $19,055 – 15.00 = $19,040
Lower bound = $19,040 / $100 = 190.40