CHAPTER 21
RISK MANAGEMENT: AN INTRODUCTION TO FINANCIAL ENGINEERING

Answers to Concepts Review and Critical Thinking Questions

1. Since the firm is selling futures, it wants to be able to deliver the lumber; therefore it is a supplier. Since a decline in lumber prices would reduce the income of a lumber supplier, it has hedged its price risk by selling lumber futures. Losses in the spot market due to a fall in lumber prices are offset by gains on the short position in lumber futures.

2. Buying call options gives the firm the right to purchase pork bellies; therefore it must be a consumer of pork bellies. While a rise in pork belly prices is bad for the consumer, this risk is offset by the gain on the call options; if pork belly prices actually decline, the consumer enjoys lower costs while the call option expires worthless.

3. Forward contracts are usually designed by the parties involved for their specific needs and are rarely sold in the secondary market; forwards are somewhat customized financial contracts. All gains and losses on the forward position are settled at the maturity date. Futures contracts are standardized to facilitate their liquidity and allow them to be effectively traded on organized futures exchanges. Gains and losses on futures are marked-to-market daily. The default risk is greatly reduced with futures, since the exchange acts as an intermediary between the two parties, guaranteeing performance; default risk is also reduced because the daily settlement procedure keeps large loss positions from accumulating. You might prefer to use forwards instead of futures if your hedging needs were different from the standard contract size and maturity dates offered by the futures contract.

4. The firm is hurt by declining oil prices, so it should sell oil futures contracts. The firm may not be able to create a perfect hedge because the quantity of oil it needs to hedge doesn't match the standard contract size on crude oil futures, or perhaps the exact settlement date the company requires isn't available on these futures (exposing the firm to basis risk), or maybe the firm produces a different grade of crude oil than that specified for delivery in the futures contract.

5. The firm is directly exposed to fluctuations in the price of natural gas, since it is a natural gas user. In addition, the firm is indirectly exposed to fluctuations in the price of oil. If oil becomes less expensive relative to natural gas, its competitors will enjoy a cost advantage relative to the firm.

6. Buying the call options is a form of insurance policy for the firm. If cotton prices rise, the firm is protected by the call, while if prices actually decline, they can just allow the call to expire worthless. However, options hedges are costly because of the initial premium that must be paid. The futures contract can be entered into at no initial cost, with the disadvantage that the firm is locking in one price for cotton; it can't profit from cotton price declines.
7. The put option on the bond gives the owner the right to sell the bond at the option's strike price. If bond prices decline, the owner of the put option profits. However, since bond prices and interest rates move in opposite directions, if the put owner profits from a decline in bond prices, he would also profit from a rise in interest rates. Hence a call option on interest rates is conceptually the same thing as a put option on bond prices.

8. The company would like to lock in the current low rates, or at least be protected from a rise in rates, allowing for the possibility of benefit if rates actually fall. The former hedge could be implemented by selling bond futures; the latter could be implemented by buying put options on bond prices or buying call options on interest rates.

9. A swap contract is an agreement between parties to exchange assets over several time intervals in the future. The swap contract is usually an exchange of cash flows, but not necessarily so. Since a forward contract is also an agreement between parties to exchange assets in the future, but at a single point in time, a swap can be viewed as a series of forward contracts with different settlement dates. The firm participating in the swap agreement is exposed to the default risk of the dealer, in that the dealer may not make the cash flow payments called for in the contract. The dealer faces the same risk from the contracting party, but can more easily hedge its default risk by entering into an offsetting swap agreement with another party.

10. The firm will borrow at a fixed rate of interest, receive fixed rate payments from the dealer as part of the swap agreement, and make floating rate payments back to the dealer; the net position of the firm is that it has effectively borrowed at floating rates.

11. Transactions exposure is the short-term exposure due to uncertain prices in the future. Economic exposure is the long-term exposure due to changes in overall economic conditions. There are a variety of instruments available to hedge transaction exposure, but very few long-term hedging instruments exist. It is much more difficult to hedge against economic exposure, since fundamental changes in the business generally must be made to offset long-run changes in the economic environment.

12. The risk is that the dollar will strengthen relative to the yen, since the fixed yen payments in the future will be worth less dollars. Since this implies a decline in the $/¥ exchange rate, the firm should sell yen futures.

13. a. Buy oil and natural gas futures contracts, since these are probably your primary resource costs. If it is a coal-fired plant, a cross-hedge might be implemented by selling natural gas futures, since coal and natural gas prices are somewhat negatively related in the market; coal and natural gas are somewhat substitutable.
   b. Buy sugar and cocoa futures, since these are probably your primary commodity inputs.
   c. Sell corn futures, since a record harvest implies low corn prices.
   d. Buy silver and platinum futures, since these are primary commodity inputs required in the manufacture of photographic equipment.
   e. Sell natural gas futures, since excess supply in the market implies low prices.
   f. Assuming the bank doesn't resell its mortgage portfolio in the secondary market, buy bond futures.
   g. Sell stock index futures, using an index most closely associated with the stocks in your fund; such as the S&P 100 or the Major Market Index for large blue-chip stocks.
h. Buy Swiss franc futures, since the risk is that the dollar will weaken relative to the franc over the next six months, which implies a rise in the $/SFr exchange rate.

i. Sell deutsche mark futures, since the risk is that the dollar will strengthen relative to the DM over the next three months, which implies a decline in the $/DM exchange rate.

14. a. Analog must have felt that the combination of fixed plus swap would result in an overall better rate than a simple split. Possible reasons include economies of scale on the single issue as opposed to two issues. Also, the variable rate available via swap may have been more attractive than the rate available from a floating issue.

b. Not a great deal. The only concern would be Analog’s exposure to fluctuating interest rates on the variable rate swap. Conceivably, an adverse move in interest rates could impact Analog’s overall ability to meet interest obligations.

c. A primary motivation is that the interest rate on the variable loan may have been substantially lower. The danger is that it won’t stay that way.

d. It’s really up to the bondholders. Analog is ultimately responsible for the making the payments as they come due whether a swap agreement exists or not. As long as the swap does not materially affect Analog’s financial condition, then the bondholders may not care. On the other hand, the bondholders are free to prohibit the swap via the indenture if they so choose.

e. Commonly, it would be some one who would like to borrow at a fixed rate, but either cannot do so, or cannot do so at a rate as attractive as that available from the swap.

Solutions to Questions and Problems

Basic

1. Initial contract value = \((1,456 \text{ per ton})(10 \text{ tons per contract}) = 14,560\)
   Final contract value = \((1,500 \text{ per ton})(10 \text{ tons per contract}) = 15,000\)
   Gain on futures contract = \(15,000 - 14,560 = 440\)

2. Initial contract value = \((0.9735 \text{ per lb})(25,000 \text{ lbs per contract}) = 24,337.50\)
   \(F_T = 1.10:\) Final contract value = \((1.10 \text{ per lb})(25,000 \text{ lbs per contract}) = 27,500\)
   since this is a short position, there is a net loss of \(24,337.50 - 27,500.00 = 3,162.50\)
   \(F_T = 0.80:\) Final contract value = \((0.80 \text{ per lb})(25,000 \text{ lbs per contract}) = 20,000\)
   since this is a short position, there is a net gain of \(24,337.50 - 20,000 = 4,337.50\)

3. Cost = \(0.72 \text{ per barrel} = (1.13 \text{ per barrel})(1,000 \text{ barrels per contract}) = 1,130 \text{ per contract}\)
   \(F_T = 22:\) the option finishes out of the money; loss = \$1,130
   \(F_T = 27:\) the option finishes in the money; profit = \((27 - 25)(1,000) = 1,130 = 870\)
4. The call options give the manager the right to purchase oil futures contracts at a futures price of $20 per barrel. The manager will exercise the option if the price rises above $20. Selling put options obligates the manager to buy oil futures contracts at a futures price of $20 per barrel. The put holder will exercise the option if the price falls below $20. The payoffs per barrel are:

<table>
<thead>
<tr>
<th>Oil futures price:</th>
<th>$12</th>
<th>$17</th>
<th>$20</th>
<th>$23</th>
<th>$28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of call option position:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Value of put option position:</td>
<td>-8</td>
<td>-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total value:</td>
<td>-8</td>
<td>-3</td>
<td>0</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

The payoff profile is identical to that of a forward contract with a $20 strike price.

Intermediate

5. a. You’re concerned about a rise in copper prices, so you would buy 100,000/25,000 = 4 September copper futures contracts. By doing so, you’re effectively locking in the settle price on January 2, 1997 of $0.9570 per pound of copper, or $95,700.

b. final contract value = ($1.10 per lb.)25,000 lbs. per contract(4 contracts) = $110,000 gain = $110,000 - $95,700 = $14,300. While the price of the copper your firm needs has become $14,300 more expensive since January, your profit from the futures position has netted out this higher cost.

6. a. XYZ has a comparative advantage relative to ABC in borrowing at fixed interest rates, while ABC has a comparative advantage relative to XYZ in borrowing at floating interest rates. Since the spread between ABC and XYZ's fixed rate costs is only 1% while their differential is 2% in floating rate markets, there is an opportunity for a 3% total gain by entering into a fixed for floating rate swap agreement.

b. If the swap dealer must capture 2% of the available gain, there is 1% left for ABC and XYZ. Any division of that gain is feasible; in an actual swap deal, the divisions would probably be negotiated by the dealer. One possible combination is 3% for ABC and 5% for XYZ:

```
  10.5%  
  +1%    
  ABC    
       LIBOR +1% 
       Dealer 
               10.0%  
               LIBOR +2.5% 
      10%              
       XYZ            
       Debt Market   
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**Challenge**

7. The financial engineer can replicate the payoffs of owning a put option by selling a forward contract and buying a call. For example, suppose the forward contract has a settle price of $50 and the exercise price of the call is also $50. The payoffs below show that the position is the same as owning a put with an exercise price of $50:

<table>
<thead>
<tr>
<th>Price of coal:</th>
<th>$40</th>
<th>$45</th>
<th>$50</th>
<th>$55</th>
<th>$60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of call option position:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Value of forward position:</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>-5</td>
<td>-10</td>
</tr>
<tr>
<td><strong>Total value:</strong></td>
<td>$10</td>
<td>$5</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Value of put position:</td>
<td>$10</td>
<td>$5</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

The payoffs for the combined position are exactly the same as those of owning a put. This means that, in general, the relationship between puts, calls, and forwards must be such that the cost of the two strategies will be the same, or an arbitrage opportunity exists. In general, given any two of the instruments, the third can be synthesized.