

- Jarrow, R. A., and G. S. Oldfield, "Forward Contracts and Futures Contracts," *Journal of Financial Economics*, 9 (December 1981), 373-82.
- Kane, E. J., "Market Incompleteness and Divergences between Forward and Futures Interest Rates," *Journal of Finance*, 35 (May 1980), 221-34.
- Richard, S., and M. Sundaresan, "A Continuous-Time Model of Forward and Futures Prices in a Multigood Economy," *Journal of Financial Economics*, 9 (December 1981), 347-72.

---

## QUESTIONS AND PROBLEMS (ANSWERS IN SOLUTIONS MANUAL)

---

- 3.1. A bank quotes you an interest rate of 14% per annum with quarterly compounding. What is the equivalent rate with (a) continuous compounding and (b) annual compounding?
- 3.2. Explain what happens when an investor shorts a certain share.
- 3.3. Suppose that you enter into a six-month forward contract on a non-dividend-paying stock when the stock price is \$30 and the risk-free interest rate (with continuous compounding) is 12% per annum. What is the forward price?
- 3.4. A stock index currently stands at 350. The risk-free interest rate is 8% per annum (with continuous compounding) and the dividend yield on the index is 4% per annum. What should the futures price for a four-month contract be?
- 3.5. Explain carefully why the futures price of gold can be calculated from its spot price and other observable variables whereas the futures price of copper cannot.
- 3.6. Explain carefully the meaning of the terms *convenience yield* and *cost of carry*. What is the relationship between futures price, spot price, convenience yield, and cost of carry?
- 3.7. Is the futures price of a stock index greater than or less than the expected future value of the index? Explain your answer.
- 3.8. An investor receives \$1,100 in one year in return for an investment of \$1,000 now. Calculate the percentage return per annum with
  - a. Annual compounding
  - b. Semiannual compounding
  - c. Monthly compounding
  - d. Continuous compounding
- 3.9. What rate of interest with continuous compounding is equivalent to 15% per annum with monthly compounding?
- 3.10. A deposit account pays 12% per annum with continuous compounding, but interest is actually paid quarterly. How much interest will be paid each quarter on a \$10,000 deposit?
- 3.11. A one-year long forward contract on a non-dividend-paying stock is entered into when the stock price is \$40 and the risk-free rate of interest is 10% per annum with continuous compounding.
  - a. What are the forward price and the initial value of the forward contract?
  - b. Six months later, the price of the stock is \$45 and the risk-free interest rate is still 10%. What are the forward price and the value of the forward contract?
- 3.12. The risk-free rate of interest is 7% per annum with continuous compounding, and the dividend yield on a stock index is 3.2% per annum. The current value of the index is 150. What is the six-month futures price?

- 3.13. Assume that the risk-free interest rate is 9% per annum with continuous compounding and that the dividend yield on a stock index varies throughout the year. In February, May, August, and November, dividends are paid at a rate of 5% per annum. In other months, dividends are paid at a rate of 2% per annum. Suppose that the value of the index on July 31, 2002, is 300. What is the futures price for a contract deliverable on December 31, 2002?
- 3.14. Suppose that the risk-free interest rate is 10% per annum with continuous compounding and that the dividend yield on a stock index is 4% per annum. The index is standing at 400, and the futures price for a contract deliverable in four months is 405. What arbitrage opportunities does this create?
- 3.15. Estimate the difference between short-term interest rates in Mexico and the United States on March 15, 2001, from the information in Table 3.3.
- 3.16. The two-month interest rates in Switzerland and the United States are 3% and 8% per annum, respectively, with continuous compounding. The spot price of the Swiss franc is \$0.6500. The futures price for a contract deliverable in two months is \$0.6600. What arbitrage opportunities does this create?
- 3.17. The current price of silver is \$9 per ounce. The storage costs are \$0.24 per ounce per year payable quarterly in advance. Assuming that interest rates are 10% per annum for all maturities, calculate the futures price of silver for delivery in nine months.
- 3.18. Suppose that  $F_1$  and  $F_2$  are two futures contracts on the same commodity with times to maturity,  $t_1$  and  $t_2$ , where  $t_2 > t_1$ . Prove that

$$F_2 \leq F_1 e^{r(t_2 - t_1)}$$

where  $r$  is the interest rate (assumed constant) and there are no storage costs. For the purposes of this problem, assume that a futures contract is the same as a forward contract.

- 3.19. When a known future cash outflow in a foreign currency is hedged by a company using a forward contract, there is no foreign exchange risk. When it is hedged using futures contracts, the marking-to-market process does leave the company exposed to some risk. Explain the nature of this risk. In particular, consider whether the company is better off using a futures contract or a forward contract when
- The value of the foreign currency falls rapidly during the life of the contract
  - The value of the foreign currency rises rapidly during the life of the contract
  - The value of the foreign currency first rises and then falls back to its initial value
  - The value of the foreign currency first falls and then rises back to its initial value
- Assume that the forward price equals the futures price.
- 3.20. It is sometimes argued that a forward exchange rate is an unbiased predictor of future exchange rates. Under what circumstances is this so?
- 3.21. Show that the growth rate in an index futures price equals the excess return of the index over the risk-free rate. Assume that the risk-free interest rate and the dividend yield are constant.
- 3.22. Show that equation (3.7) is true by considering an investment in the asset combined with a short position in a futures contract. Assume that all income from the asset is reinvested in the asset. Use an argument similar to that in footnotes 2 and 4 and explain in detail what an arbitrageur would do if equation (3.7) did not hold.
- 3.23. The Value Line Index is designed to reflect changes in the value of a portfolio of over 1,600 equally weighted stocks. Prior to March 9, 1988, the change in the index from one day to the next was calculated as the *geometric* average of the changes in the prices of the stocks underlying the index. In these circumstances, does equation (3.12) correctly relate the futures price of the index to its cash price? If not, does the equation overstate or understate the futures price?

---

## ASSIGNMENT QUESTIONS

---

- 3.24. A stock is expected to pay a dividend of \$1 per share in two months and in five months. The stock price is \$50, and the risk-free rate of interest is 8% per annum with continuous compounding for all maturities. An investor has just taken a short position in a six-month forward contract on the stock.
- What are the forward price and the initial value of the forward contract?
  - Three months later, the price of the stock is \$48 and the risk-free rate of interest is still 8% per annum. What are the forward price and the value of the short position in the forward contract?
- 3.25. A bank offers a corporate client a choice between borrowing cash at 11% per annum and borrowing gold at 2% per annum. (If gold is borrowed, interest must be repaid in gold. Thus, 100 ounces borrowed today would require 102 ounces to be repaid in one year.) The risk-free interest rate is 9.25% per annum, and storage costs are 0.5% per annum. Discuss whether the rate of interest on the gold loan is too high or too low in relation to the rate of interest on the cash loan. The interest rates on the two loans are expressed with annual compounding. The risk-free interest rate and storage costs are expressed with continuous compounding. Assume that no income is earned on gold. Repeat your calculations for the situation where income of 1.5% per annum can be earned on gold.
- 3.26. A company that is uncertain about the exact date when it will pay or receive a foreign currency may try to negotiate with its bank a forward contract that specifies a period during which delivery can be made. The company wants to reserve the right to choose the exact delivery date to fit in with its own cash flows. Put yourself in the position of the bank. How would you price the product that the company wants?
- 3.27. A foreign exchange trader working for a bank enters into a long forward contract to buy one million pounds sterling at an exchange rate of 1.6000 in three months. At the same time, another trader on the next desk takes a long position in 16 three-month futures contracts on sterling. The futures price is 1.6000, and each contract is on 62,500 pounds. Within minutes of the trades being executed the forward and the futures prices both increase to 1.6040. Both traders immediately claim a profit of \$4,000. The bank's systems show that the futures trader has made a \$4,000 profit, but the forward trader has made a profit of only \$3,900. The forward trader immediately picks up the phone to complain to the systems department. Explain what is going on here. Why are the profits different?
- 3.28. A company enters into a forward contract with a bank to sell a foreign currency for  $K_1$  at time  $T_1$ . The exchange rate at time  $T_1$  proves to be  $S_1 (> K_1)$ . The company asks the bank if it can roll the contract forward until time  $T_2 (> T_1)$  rather than settle at time  $T_1$ . The bank agrees to a new delivery price,  $K_2$ . Explain how  $K_2$  should be calculated.