Assignment 12

1. **Problem 1 (10 points)** A stock is trading at $24.50. The market consensus expectation is that it will pay a dividend of $0.50 in two months' time. No other payouts are expected on the stock over the next three months. Assume interest rates are constant at 6% for all maturities. You enter into a long position to buy 10,000 shares of stock in three months' time.

   (a) What is the arbitrage-free price of the three-month forward contract?

   (b) After one month, the stock is trading at $23.50. What is the value of your forward contract?

   (c) Now suppose that at this point, the company unexpectedly announces that dividends will be $1.00 per share due to larger-than-expected earnings. Buoyed by the good news, the share price jumps up to $24.50. What is now the value of your forward contract?

2. **Problem 2 (10 points)** The SPX index is currently trading at a value of $1,265, and the Dow Jones EuroSTOXX Index of 50 stocks, referred to from here on as "STOXX", is trading at EUR 3,671. The dollar interest rate is 3%, and the euro interest rate is 5%. The exchange rate is $1.28/EUR. The six-month futures on the STOXX is quoted at EUR 3,782. All interest rates are continuously compounded. There are no borrowing costs for securities.

   (a) Compute the correct six-month forward prices of the SPX and STOXX, as well as the forward price between the dollar and the euro.

   (b) Is the futures on the STOXX correctly priced? If not, show how to undertake an arbitrage strategy assuming you are not allowed to undertake borrowing or lending transactions in either currency.

3. **Problem 3 (5 points)** Triangular arbitrage is a strategy that exploits an arbitrage opportunity resulting from a pricing discrepancy among three different currencies in the foreign exchange market. A triangular arbitrage strategy involves three trades, exchanging the initial currency for a second, the second currency for a third, and the third currency for the initial. Consider three exchange rate, dollar/euro, yen/euro

and yen/dollar. Provided below are their spot FX rates and one-year interest rates (continuously compounded):

Spot FX rates: dollar/euro = 1.2822, yen/euro = 146.15, and yen/dollar = 113.98.

Interest rates: dollar = 3%, euro = 5%, and yen = 1%.

(a) Check whether triangular arbitrage exists in the spot FX market.

(b) Suppose, as it is the case in practice, that the FX trading desk of a larger bank makes markets in FX forwards for all major currencies. Assume further that the bank employs one trader for each currency pair, and that the traders do not talk to each other. If each trader sets prices using the arbitrage-free pricing approach (assume zero bid-offer spread) does triangular arbitrage exist in the one-year forward FX market?

4. **Problem 4 (5 points)** Suppose you are given the following information:

- The current price of copper is $83.55 per 100 lbs.

- The term-structure of interest rates is 5%, i.e., the risk-free interest rate for borrowing/investment is 5% for all maturities in continuously-compounded and annualized terms.

- You can take long and short positions in copper costlessly.

- There are no costs of storing or holding copper.

Consider a forward contract in which the short position has to make *two* deliveries: 10,000 lbs of copper in one month, and 10,000 lbs in two months. The common delivery price in the contract for both deliveries is P, that is, the short position receives P upon making the one-month delivery and P upon making the two-month delivery. What is the arbitrage-free value of P?