PROBLEM SETS

1. In formulating a hedge position, a stock’s beta and a bond’s duration are used similarly to determine the expected percentage gain or loss in the value of the underlying asset for a given change in market conditions. Then, in each of these markets, the expected percentage change in value is used to calculate the expected dollar change in value of the stock or bond portfolios, respectively. Finally, the dollar change in value of the underlying asset, along with the dollar change in the value of the futures contract, determines the hedge ratio.

The major difference in the calculations necessary to formulate a hedge position in each market lies in the manner in which the first step identified above is computed. For a hedge in the equity market, the product of the equity portfolio’s beta with respect to the given market index and the expected percentage change in the index for the futures contract equals the expected percentage change in the value of the portfolio. Clearly, if the portfolio has a positive beta and the investor is concerned about hedging against a decline in the index, the result of this calculation is a decrease in the value of the portfolio. For a hedge in the fixed income market, the product of the bond’s modified duration and the expected change in the bond’s yield equals the expected percentage change in the value of the bond. Here, the investor who has a long position in a bond (or a bond portfolio) is concerned about the possibility of an increase in yield, and the resulting change in the bond’s value is a loss.

A secondary difference in the calculations necessary to formulate a hedge position in each market arises in the calculation of the hedge ratio. In the equity market, the hedge ratio is typically calculated by dividing the total expected dollar change in the value of the portfolio (for a given change in the index) by the profit (i.e., the dollar change in value) on one futures contract (for the given change in the index). In the bond market, the comparable calculation is generally thought of in terms of the price value of a basis point (PVBP) for the bond and the PVBP for the futures contract, rather than in terms of the total dollar change in both the value of the portfolio and the value of a single futures contract.
2. One of the considerations that would enter into the hedging strategy for a U.S. exporting firm with outstanding bills to its customers denominated in foreign currency is whether the U.S. firm also has outstanding payables denominated in the same foreign currency. Since the firm receives foreign currency when its customers’ bills are paid, the firm hedges by taking a short position in the foreign currency. The U.S. firm would reduce its short position in futures to the extent that outstanding payables offset outstanding receivables with the same maturity because the outstanding payables effectively hedge the exchange rate risk of the outstanding receivables. Equivalently, if the U.S. firm expects to incur ongoing obligations denominated in the same foreign currency in order to meet expenses required to deliver additional products to its customers, then the firm would reduce its short position in the foreign currency futures. In general, if the U.S. firm incurs expenses in the same foreign currency, then the firm would take a short position in the currency futures to hedge its profits measured in the foreign currency. If the U.S. firm incurs all of its expenses in U.S. dollars, but bills its customers in the foreign currency, then the firm would take a position to hedge the outstanding receivables, not just the profit. Another consideration that affects the U.S. exporting firm’s willingness to hedge its exchange rate risk is the impact of depreciation of the foreign currency on the firm’s prices for its products. For a U.S. firm that sets its prices in the foreign currency, the dollar-equivalent price of the firm’s products is reduced when the foreign currency depreciates, so that the firm is likely to find it desirable to increase its short position in currency futures to hedge against this risk. If the U.S. firm is not able to increase the price of its products in the foreign currency due to competition, the depreciation of the foreign currency has an impact on profits similar to the impact of foreign currency depreciation on the U.S. firm’s receivables.

3. The hedge will be much more effective for the gold-producing firm. Prices for distant maturity oil futures contracts have surprisingly low correlation with current prices because convenience yields and storage costs for oil can change dramatically over time. When near-term oil prices fall, there may be little or no change in longer-term prices, since oil prices for very distant delivery generally respond only slightly to changes in the current market for short-horizon oil. Because the correlation between short- and long-maturity oil futures is so low, hedging long term commitments with short maturity contracts does little to eliminate risk; that is, such a hedge eliminates very little of the variance entailed in uncertain future oil prices.

In contrast, both convenience yields and storage costs for gold are substantially smaller and more stable; the result is that the correlation between short-term and more distant gold futures prices is substantially greater. In other words, the basis between near and distant maturity gold futures prices is far less variable, so hedging long-term prices with short-term gold contracts results in a substantially greater percentage reduction in volatility.
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4. Municipal bond yields, which are below T-bond yields because of their tax-exempt status, are expected to close in on Treasury yields. Because yields and prices are inversely related, this means that municipal bond prices will perform poorly compared to Treasuries. Therefore you should establish a spread position, buying Treasury-bond futures and selling municipal bond futures. The net bet on the general level of interest rates is approximately zero. You have simply made a bet on relative performances in the two sectors.

5. a. \( S_0 \times (1 + r_M) - D = (1,425 \times 1.06) - 15 = 1,495.50 \)

   b. \( S_0 \times (1 + r_f) - D = (1,425 \times 1.03) - 15 = 1,452.75 \)

   c. The futures price is too low. Buy futures, short the index, and invest the proceeds of the short sale in T-bills:

<table>
<thead>
<tr>
<th>CF Now</th>
<th>CF in 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy futures</td>
<td>0</td>
</tr>
<tr>
<td>Short index</td>
<td>1,425</td>
</tr>
<tr>
<td>Buy T-bills</td>
<td>(-1,425)</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

6. a. The value of the underlying stock is:
   
   \$250 \times 1,350 = $337,500
   
   \$25/$337,500 = 0.000074 = 0.0074% of the value of the stock

   b. \$40 \times 0.000074 = $0.0030 (less than half of one cent)

   c. \$0.15/$0.0030 = 50
   
   The transaction cost in the stock market is 50 times the transaction cost in the futures market.
7. a. You should be short the index futures contracts. If the stock value falls, you need futures profits to offset the loss.

   b. Each contract is for $250 times the index, currently valued at 1,350. Therefore, each contract controls stock worth: $250 \times 1,350 = $337,500

   In order to hedge a $13.5 million portfolio, you need:

   \[
   \frac{13,500,000}{337,500} = 40 \text{ contracts}
   \]

   c. Now, your stock swings only 0.6 as much as the market index. Hence, you need 0.6 as many contracts as in (b): 0.6 \times 40 = 24 \text{ contracts}

8. If the beta of the portfolio were 1.0, she would sell $1 million of the index. Because beta is 1.25, she should sell $1.25 million of the index.

9. You would short $0.50 of the market index contract and $0.75 of the computer industry stock for each dollar held in IBM.

10. The dollar is depreciating relative to the euro. To induce investors to invest in the U.S., the U.S. interest rate must be higher.

11. a. From parity: 

   \[
   F_0 = E_0 \times \frac{1 + r_{US}}{1 + r_{UK}} = 2.00 \times \frac{1.04}{1.06} = 1.962
   \]

   b. Suppose that \( F_0 = $2.03/£ \). Then dollars are relatively too cheap in the forward market, or equivalently, pounds are too expensive. Therefore, you should borrow the present value of £1, use the proceeds to buy pound-denominated bills in the spot market, and sell £1 forward:

<table>
<thead>
<tr>
<th>Action Now</th>
<th>CF in $</th>
<th>Action at period-end</th>
<th>CF in $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sell £1 forward for $2.03</td>
<td>0</td>
<td>Collect $2.03, deliver £1</td>
<td>$2.03 – $E_1</td>
</tr>
<tr>
<td>Buy £1/1.06 in spot market; invest at the British risk-free rate</td>
<td>−2.00/1.06 = −$1.887</td>
<td>Exchange £1 for $E_1</td>
<td>$E_1</td>
</tr>
<tr>
<td>Borrow $1.887</td>
<td>$1.887</td>
<td>Repay loan; U.S. interest rate = 4%</td>
<td>−$1.962</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>Total</td>
<td>$0.068</td>
</tr>
</tbody>
</table>
12. a. Lend in the U.K.
   b. Borrow in the U.S.
   c. Borrowing in the U.S. offers a 4% rate of return. Borrowing in the U.K. and covering interest rate risk with futures or forwards offers a rate of return of:

   \[ r_{US} = \left(1 + r_{UK} \right) \times \frac{F_0}{E_0} - 1 = \left[ 1.07 \times \frac{1.98}{2.00} \right] - 1 = 0.0593 = 5.93\% \]

   It appears advantageous to borrow in the U.S., where rates are lower, and to lend in the U.K. An arbitrage strategy involves simultaneous lending and borrowing with the covering of interest rate risk:

<table>
<thead>
<tr>
<th>Action Now</th>
<th>CF in $</th>
<th>Action at period-end</th>
<th>CF in $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borrow $2.00 in U.S.</td>
<td>$2.00</td>
<td>Repay loan</td>
<td>–$2.00  × 1.04</td>
</tr>
<tr>
<td>Convert borrowed dollars to pounds; lend £1 pound in U.K.</td>
<td>–$2.00</td>
<td>Collect repayment; exchange proceeds for dollars</td>
<td>1.07 × E1</td>
</tr>
<tr>
<td>Sell forward £1.07 at ( F_0 = 1.98 )</td>
<td>0</td>
<td>Unwind forward</td>
<td>1.07 × (1.98 – E1)</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>Total</td>
<td>$0.0386</td>
</tr>
</tbody>
</table>

13. The farmer must sell forward:

   \[ 100,000 \times \left(1/0.90\right) = 111,111 \text{ bushels of yellow corn} \]

   This requires selling: 111,111/5,000 = 22.2 contracts

14. The closing futures price will be: \( 100 - 4.80 = 95.20 \)

   The initial futures price was 95.4525, so the loss to the long side is 25.25 basis points or:

   \[ 25.25 \text{ basis points} \times 25 \text{ per basis point} = 631.25 \]

   The loss can also be computed as:

   \[ 0.002525 \times \frac{1}{4} \times 1,000,000 = 631.25 \]

15. Suppose the yield on your portfolio increases by 1.5 basis points. Then the yield on the T-bond contract is likely to increase by 1 basis point. The loss on your portfolio will be:

   \[ 1 \text{ million} \times \Delta y \times \Delta = 1,000,000 \times 0.00015 \times 4 = 600 \]

   The change in the futures price (per $100 par value) will be:

   \[ 95 \times 0.0001 \times 9 = 0.0855 \]

   This is a change of $85.50 on a $100,000 par value contract. Therefore you should sell:

   \[ 600/85.50 = 7 \text{ contracts} \]
16. She must sell: $1 million \times \frac{8}{10} = $0.8 million of T-bonds

17. If yield changes on the bond and the contracts are each 1 basis point, then the bond value will change by:

\[
$10,000,000 \times 0.0001 \times 8 = $8,000
\]

The contract will result in a cash flow of:

\[
$100,000 \times 0.0001 \times 6 = $60
\]

Therefore, the firm should sell: $8,000/60 = 133 contracts

The firm sells the contracts because you need profits on the contract to offset losses as a bond issuer if interest rates increase.

18. \( F_0 = S_0(1 + r_f)^T = 880 \times 1.04 = 915.20 \)

If \( F_0 = 920 \), you could earn arbitrage profits as follows:

<table>
<thead>
<tr>
<th>CF Now</th>
<th>CF in 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy gold</td>
<td>–880</td>
</tr>
<tr>
<td>Short futures</td>
<td>0</td>
</tr>
<tr>
<td>Borrow $880</td>
<td>880</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

The forward price must be 915.20 in order for this strategy to yield no profit.

19. If a poor harvest today indicates a worse than average harvest in future years, then the futures prices will rise in response to today’s harvest, although presumably the two-year price will change by less than the one-year price. The same reasoning holds if corn is stored across the harvest. Next year’s price is determined by the available supply at harvest time, which is the actual harvest plus the stored corn. A smaller harvest today means less stored corn for next year which can lead to higher prices.

Suppose first that corn is never stored across a harvest, and second that the quality of a harvest is not related to the quality of past harvests. Under these circumstances, there is no link between the current price of corn and the expected future price of corn. The quantity of corn stored will fall to zero before the next harvest, and thus the quantity of corn and the price in one year will depend solely on the quantity of next year’s harvest, which has nothing to do with this year’s harvest.
20. The required rate of return on an asset with the same risk as corn is:
   \[ 1\% + 0.5(1.8\% - 1\%) = 1.4\% \text{ per month} \]
   Thus, in the absence of storage costs, three months from now corn would sell for:
   \[ $2.75 \times 1.014^3 = $2.867 \]
   The future value of 3 month’s storage costs is:
   \[ $0.03 \times \text{FA}(1\%, 3) = $0.091 \]
   where FA stands for the future value factor for a level annuity with a given interest rate
   and number of payments. Thus, in order to induce storage, the expected price would have
   to be:
   \[ $2.867 + $0.091 = $2.958 \]
   Because the expected spot price is only $2.94, you would not store corn.

21. If the exchange of currencies were structured as three separate forward contracts, the
    forward prices would be determined as follows:
    Forward exchange rate \times $1 million euros = dollars to be delivered
    Year 1: \[ 1.50 \times (1.04/1.03) \times $1 \text{ million euros} = $1.5146 \text{ million} \]
    Year 2: \[ 1.50 \times (1.04/1.03)^2 \times $1 \text{ million euros} = $1.5293 \text{ million} \]
    Year 3: \[ 1.50 \times (1.04/1.03)^3 \times $1 \text{ million euros} = $1.5441 \text{ million} \]
    Instead, we deliver the same number of dollars (F*) each year. The value of F* is
determined by first computing the present value of this obligation:
    \[ \frac{F^*}{1.04^1} + \frac{F^*}{1.04^2} + \frac{F^*}{1.04^3} = \frac{1.5146}{1.04^1} + \frac{1.5293}{1.04^2} + \frac{1.5441}{1.04^3} = 4.2430 \]
    F* equals $1.5290 million per year.

22. a. The swap rate moved in favor of firm ABC. ABC should have received 1% more
    per year than it could receive in the current swap market. Based on notional
    principal of $10 million, the loss is:
    \[ 0.01 \times $10 \text{ million} = $100,000 \text{ per year} \]
    b. The market value of the fixed annual loss is obtained by discounting at the current
    7% rate on 3-year swaps. The loss is:
    \[ $100,000 \times \text{Annuity factor (7\%, 3)} = $262,432 \]
    c. If ABC had become insolvent, XYZ would not be harmed. XYZ would be happy
to see the swap agreement cancelled. However, the swap agreement ought to be
    treated as an asset of ABC when the firm is reorganized.
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23. The firm receives a fixed rate that is 2% higher than the market rate. The extra payment of \((0.02 \times $10 \text{ million})\) has present value equal to:
\[ $200,000 \times \text{Annuity factor (8\%, 5)} = $799,542 \]

24. 
   a. From parity: \(F_0 = 1,200 \times (1 + 0.03) – 15 = 1,221\)
   Actual \(F_0\) is 1,218; so the futures price is 3 below the “proper” level.

   b. Buy the relatively cheap futures, sell the relatively expensive stock and lend the proceeds of the short sale:

<table>
<thead>
<tr>
<th>CF Now</th>
<th>CF in 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy futures</td>
<td>0</td>
</tr>
<tr>
<td>Sell shares</td>
<td>1,200</td>
</tr>
<tr>
<td>Lend $1,200</td>
<td>-1,200</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

   c. If you do not receive interest on the proceeds of the short sales, then the \$1200 you receive will not be invested but will simply be returned to you. The proceeds from the strategy in part (b) are now negative: an arbitrage opportunity no longer exists.

<table>
<thead>
<tr>
<th>CF Now</th>
<th>CF in 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy futures</td>
<td>0</td>
</tr>
<tr>
<td>Sell shares</td>
<td>1,200</td>
</tr>
<tr>
<td>Place $1,200 in margin account</td>
<td>-1,200</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

   d. If we call the original futures price \(F_0\), then the proceeds from the long-futures, short-stock strategy are:

<table>
<thead>
<tr>
<th>CF Now</th>
<th>CF in 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy futures</td>
<td>0</td>
</tr>
<tr>
<td>Sell shares</td>
<td>1,200</td>
</tr>
<tr>
<td>Place $1,200 in margin account</td>
<td>-1,200</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

Therefore, \(F_0\) can be as low as 1,185 without giving rise to an arbitrage opportunity. On the other hand, if \(F_0\) is higher than the parity value (1,221), then an arbitrage opportunity (buy stocks, sell futures) will exist. There is no short-selling cost in this case. Therefore, the no-arbitrage range is:
\[ 1,185 \leq F_0 \leq 1,221 \]
25. a. Call $p$ the fraction of proceeds from the short sale to which we have access. Ignoring transaction costs, the lower bound on the futures price that precludes arbitrage is the following usual parity value (except for the factor $p$):

$$S_0 (1 + r_f p) - D$$

The dividend ($D$) equals: $0.012 \times 1,350 = $16.20

The factor $p$ arises because only this fraction of the proceeds from the short sale can be invested in the risk-free asset. We can solve for $p$ as follows:

$$1,350 \times (1 + 0.022p) - 16.20 = 1,351 \Rightarrow p = 0.579$$

b. With $p = 0.9$, the no-arbitrage lower bound on the futures price is:

$$1,350 \times [1 + (0.022 \times 0.9)] - 16.20 = 1,360.53$$

The actual futures price is 1,351. The departure from the bound is therefore 9.53. This departure also equals the potential profit from an arbitrage strategy. The strategy is to short the stock, which currently sells at 1,350. The investor receives 90% of the proceeds (1,215) and the remainder (135) remains in the margin account until the short position is covered in 6 months. The investor buys futures and lends 1,215:

<table>
<thead>
<tr>
<th>CF Now</th>
<th>CF in 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy futures</td>
<td>0</td>
</tr>
<tr>
<td>Sell shares</td>
<td>1350 – 135</td>
</tr>
<tr>
<td>Lend</td>
<td>$-1,215$</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

The profit is: $9.53 \times $250 per contract = $2,382.50

### CFA PROBLEMS

1. a. By spot-futures parity:

$$F_0 = S_0 \times (1 + r_f) = 185 \times [1 + (0.06/2)] = 190.55$$

b. The lower bound is based on the reverse cash-and-carry strategy.

<table>
<thead>
<tr>
<th>Action Now</th>
<th>CF in $</th>
<th>Action at period-end</th>
<th>CF in $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy one TOBEC index futures contract</td>
<td>0</td>
<td>Sell one TOBEC index futures contract</td>
<td>$100 \times (F_1 - F_0)$</td>
</tr>
<tr>
<td>Sell spot TOBEC index</td>
<td>+$18,500</td>
<td>Buy spot TOBEC index</td>
<td>$-100 \times S_1$</td>
</tr>
<tr>
<td>Lend $18,500</td>
<td>$-18,500</td>
<td>Collect loan repayment</td>
<td>$18,500 \times 1.03 = +$19,055</td>
</tr>
<tr>
<td>Pay transaction costs</td>
<td></td>
<td></td>
<td>$-15.00$</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>Total</td>
<td>$-100F_0 + 19,040$</td>
</tr>
</tbody>
</table>

(Note that $F_1 = S_1$ at expiration.)

The lower bound for $F_0$ is: $19,040/100 = 190.40$
2. a. The strategy would be to sell Japanese stock index futures to hedge the market risk of Japanese stocks, and to sell yen futures to hedge the currency exposure.

b. Some possible practical difficulties with this strategy include:
   • Contract size on futures may not match size of portfolio.
   • Stock portfolio may not closely track index portfolios on which futures trade.
   • Cash flow management issues from marking to market.
   • Potential mispricing of futures contracts (violations of parity).

3. a. The hedged investment involves converting the $1 million to foreign currency, investing in that country, and selling forward the foreign currency in order to lock in the dollar value of the investment. Because the interest rates are for 90-day periods, we assume they are quoted as bond equivalent yields, annualized using simple interest. Therefore, to express rates on a per quarter basis, we divide these rates by 4:

<table>
<thead>
<tr>
<th></th>
<th>Japanese government</th>
<th>Swiss government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert $1 million</td>
<td>$1,000,000 × 133.05 =</td>
<td>$1,000,000 × 1.5260 =</td>
</tr>
<tr>
<td>to local currency</td>
<td>¥133,050,000</td>
<td>SF1,526,000</td>
</tr>
<tr>
<td>Invest in local currency for 90 days</td>
<td>¥133,050,000 × [1 + (0.076/4)] =</td>
<td>SF1,526,000 × [1 + (0.086/4)] =</td>
</tr>
<tr>
<td></td>
<td>¥135,577,950</td>
<td>SF1,558,809</td>
</tr>
<tr>
<td>Convert to $ at 90-day forward rate</td>
<td>135,577,950/133.47 = $1,015,793</td>
<td>1,558,809/1.5348 = $1,015,643</td>
</tr>
</tbody>
</table>

b. The results in the two currencies are nearly identical. This near-equality reflects the interest rate parity theorem. This theory asserts that the pricing relationships between interest rates and spot and forward exchange rates must make covered (that is, fully hedged and riskless) investments in any currency equally attractive.

c. The 90-day return in Japan is 1.5793%, which represents a bond-equivalent yield of 1.5793% × 365/90 = 6.405%. The 90-day return in Switzerland is 1.5643%, which represents a bond-equivalent yield of 1.5643% × 365/90 = 6.344%. The estimate for the 90-day risk-free U.S. government money market yield is in this range.
4. The investor can buy $X$ amount of pesos at the (indirect) spot exchange rate, and invest the pesos in the Mexican bond market. Then, in one year, the investor will have:

$$X \times (1 + r_{\text{MEX}}) \text{ pesos}$$

These pesos can then be converted back into dollars using the (indirect) forward exchange rate. Interest rate parity asserts that the two holding period returns must be equal, which can be represented by the formula:

$$(1 + r_{\text{US}}) = E_0 \times (1 + r_{\text{MEX}}) \times (1/F_0)$$

The left side of the equation represents the holding period return for a U.S. dollar-denominated bond. If interest rate parity holds, then this term also corresponds to the U.S. dollar holding period return for the currency-hedged Mexican one-year bond. The right side of the equation is the holding period return, in dollar terms, for a currency-hedged peso-denominated bond. Solving for $r_{\text{US}}$:

$$(1 + r_{\text{US}}) = 9.5000 \times (1 + 0.065) \times (1/9.8707)$$

$$r_{\text{US}} = 2.50\%$$

Thus $r_{\text{US}} = 2.50\%$, which is the same as the yield for the one-year U.S. bond.

5. a. From parity:

$$F_0 = E_0 \times \left(\frac{1 + r_{\text{US}}}{1 + r_{\text{Japan}}}\right)^{0.5} = 124.30 \times \left(\frac{1.0010}{1.0380}\right)^{0.5} = 122.06453$$

b.

<table>
<thead>
<tr>
<th>Action Now</th>
<th>CF in $</th>
<th>Action at period-end</th>
<th>CF in ¥</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borrow $1,000,000 in U.S.</td>
<td>$1,000,000</td>
<td>Repay loan</td>
<td>$-1,008,637.45</td>
</tr>
<tr>
<td>Convert borrowed dollars to yen; lend ¥124,300,000 in Japan</td>
<td>¥-1,000,000</td>
<td>Collect repayment in yen</td>
<td>¥124,455,084.52</td>
</tr>
<tr>
<td>Sell forward $1,008,637.45 at $F_0 = ¥123.2605</td>
<td>0</td>
<td>Unwind forward</td>
<td>¥-124,325,156.40</td>
</tr>
</tbody>
</table>

Total 0 Total ¥129,928.12

The arbitrage profit is: ¥129,928.12

6. a. Delsing should sell stock index futures contracts and buy bond futures contracts. This strategy is justified because buying the bond futures and selling the stock index futures provides the same exposure as buying the bonds and selling the stocks. This strategy assumes high correlation between the bond futures and the bond portfolio, as well as high correlation between the stock index futures and the stock portfolio.
b. The number of contracts in each case is:
   i. \[5 \times \$200,000,000 \times 0.0001 = \$100,000\]
      \[\frac{\$100,000}{97.85} = 1022\text{ contracts}\]
   ii. \[\frac{\$200,000,000}{(\$1,378 \times 250)} = 581\text{ contracts}\]

7. **Situation A.** The market value of the portfolio to be hedged is $20 million. The market value of the bonds controlled by one futures contract is $63,330. If we were to equate the market values of the portfolio and the futures contract, we would sell:

   \[\frac{\$20,000,000}{\$63,330} = 315.806\text{ contracts}\]

   However, we must adjust this “naive” hedge for the price volatility of the bond portfolio relative to the futures contract. Price volatilities differ according to both the duration and the yield volatility of the bonds. In this case, the yield volatilities may be assumed equal, because any yield spread between the Treasury portfolio and the Treasury bond underlying the futures contract is likely to be stable. However, the duration of the Treasury portfolio is less than that of the futures contract. Adjusting the naive hedge for relative duration and relative yield volatility, we obtain the adjusted hedge position:

   \[315.806 \times \frac{7.6}{8.0} \times 1.0 = 300\text{ contracts}\]

**Situation B.** Here, the treasurer seeks to hedge the purchase price of the bonds; this requires a long hedge. The market value of the bonds to be purchased is:

   \[\$20 \text{ million} \times 0.93 = \$18.6\text{ million}\]

   The duration ratio is 7.2/8.0, and the relative yield volatility is 1.25. Therefore, the hedge requires the treasurer to take a long position in:

   \[\frac{18,600,000}{63,330} \times \frac{7.2}{8.0} \times 1.25 = 330\text{ contracts}\]

8. a. \[% \text{ change in T-bond price} = \text{modified duration} \times \text{change in YTM}\]

   \[= 7.0 \times 0.50\% = 3.5\%\]

b. When the YTM of the T-bond changes by 50 basis points, the predicted change in the yield on the KC bond is \(1.22 \times 50 = 61\) basis points. Therefore:

   \[% \text{ change in KC price} = \text{modified duration} \times \text{change in YTM}\]

   \[= 6.93 \times 0.61\% = 4.23\%\]