1. Describe the position one would take in the financial futures markets in order to hedge the interest rate risk implied by the following scenarios:

(a) Chicago Bank has $100 million in assets and $83 million in liabilities. The duration of its assets is 5.9 years and the duration of its liabilities is 1.8 years.

ANSWER: Since the bank has a positive duration gap, its net worth will be hurt if interest rates rise, or if bond prices fall. By taking a short position, the bank will hedge its exposure to this risk since if interest rates rise, bond prices will fall implying profits will be made by taking a short position.

(b) A bank issues a $3 million fully amortized mortgage requiring monthly payments. The bank plans to sell the mortgage in 6 months.

ANSWER: Again this bank will be hurt by a rise in interest rates: take a short position for the same reason as above.

(c) A savings and loan has a negative funding gap.

ANSWER: With a negative funding gap, the value of rate sensitive liabilities exceeds that of rate sensitive assets. So NIM will be hurt if interest rates rise: again, take a short position.

2. A bank has two 3-year commercial loans with a present value of $70 million. The first is a $30 million loan that requires a single payment of $37.8 million in three years, with no payments until then. The second loan is for $40 million. It requires an annual interest payment of $3.6 million. The principal of $40 million is due in three years.

(a) What is the duration of the bank’s commercial loan portfolio?

ANSWER: The duration of the $30m loan is 3 since it is a zero coupon bond. The duration of the $40m loan is determined by the formula (note since the bond is selling at par, it is the case that the yield to maturity = the coupon rate = 9%. So the duration of this loan is \[\frac{(3.6/1.09)(1) + (3.6/ (1.09^2))(2) + (43.6/ (1.09^3))(3))}{40} = 2.76\]. So the duration of the loan portfolio is \([30/70) 3 + (40/70) 2.76] = 2.86\)

(b) What will happen to the value of its portfolio if the general level of interest rates increases from 8% to 8.5%?

ANSWER: Using the duration formula: \[\Delta P = -2.86 \times \frac{0.005}{1.08} = -0.013\]. So the change in the value is \[\Delta P = -0.013(70) = -$0.91\] million. That is $910,000 is lost in value.

3. Suppose IBM can borrow long term at a fixed rate of 7% or at a floating rate of 30 bp over LIBOR. Wells Fargo can borrow long term at a fixed rate of 10% and a floating rate of 65bp over LIBOR. Design an interest rate swap that reduces the borrowing costs of both firms.
ANSWER: IBM has a comparative advantage in fixed rate debt, so IBM should issue fixed rate debt, but pays a floating rate to WF. WF will issue a floating rate but pay fix rate to IBM. Let the floating rate paid by IBM be LIBOR. Then they will agree as long as the all-in-costs for the floating rate are less than what they would pay on the market: \[ I_{B,AIC} = 7 + L - SR < L + 30 \Rightarrow \text{IBM will accept deal as long as the swap rate (SR) is greater than } 6.7\%. \] For Wells, as long as their all-in-costs are less than 10% they will accept deal (since they are paying a fixed rate): \[ W_{F,AIC} = L + 65 - L + SR < 10 \Rightarrow \text{WF will accept the deal as long SR < 9.35\%. So any swap rate in the range } 6.7\% < SR < 9.35\% \text{ will be acceptable to both parties.} \]

4. Define the following measures and describe the information they provide about bank performance: \( \text{NII, NIM, ROE, and ROA} \).

ANSWER: \( \text{NII} = (\text{Interest income} - \text{Interest expense}) \) this measures the basic business of the bank. That is, how much interest income it is generating from its assets relative to its liabilities. This is not that useful since it does not include the size of the bank’s assets. That is why \( \text{NIM} = \left(\frac{\text{NII}}{\text{Interest Earning Assets}}\right) \) is a more useful measure since this tells the bank how much income it is generating from its earning assets. So this is the measure of the average net rate of return on the interest earning assets. \( \text{ROA} \) is the return on all assets and it includes all net income (not just interest income) and is scaled by all assets: \( \text{ROA} = \left(\frac{\text{Net income}}{\text{Total Assets}}\right) \). This measure gives the broadest measure of the rate of return on the assets owned by the company. \( \text{ROE} \) measures the rate of return on equity, \( \text{ROE} = \left(\frac{\text{Net income}}{\text{Equity}}\right) \) and is the rate of return relevant for the owners of the firm since it measures the net income generated by their investment (i.e. equity). Note that, for a given \( \text{ROA} \), the \( \text{ROE} \) can be increased if the firm is more highly leveraged: \( \text{ROE} = \text{ROA} \times \left(\frac{\text{Total Assets}}{\text{Equity}}\right) \).

5. A lender forecasts inflation to be 4% over the upcoming year, 2% in following year, and 5% in the year after that. If she wants a real return of 3% every year, determine the term structure of bonds with maturities of 1, 2, and 3 years implied by the expectations hypothesis and the Fisher relation.

ANSWER: From the Fisher relation, this implies the current and expected future one period nominal interest rates are: \( i_t = 7\% \), \( i_{t+1}^e = 5\% \), \( i_{t+2}^e = 8\% \). Since, according to the expectations hypothesis, the long rates are an average of the current and expected future short rates, we have: \( i_2 = \frac{7\% + 5\%}{2} = 6\% \), \( i_3 = \frac{7\% + 5\% + 8\%}{3} = 6.67\% \).

6. In Brunnermeier’s analysis of the credit crisis, the TED spread played a critical role. Why?

ANSWER: The TED spread is the difference between LIBOR (London interbank offered rate) and the rate on a Treasury bill. This captures the risk and liquidity associated with the interbank loan market. During the course of the financial crisis, the TED spread spiked at various times as banks liquidity needs increased. For instance, banks had lines of credit issued to their subsidiaries which held CDOs; as the value of these came into question, the subsidiaries could not borrow on the open market (issue commercial paper or repurchase agreements). Consequently, they tapped their lines of credit and this increased the demand for liquidity by banks. This caused a jump in the TED spread.