EE431 Economics of Financial Markets and Institutions
Problem Set 5

Solution

1. The bank you own has the following balance sheet:

Assets		Liabilities	
Reserves	$75 million	Deposits	$500 million
Loans	$255 million	Bank Capital	$100 million

   (a) If the bank suffers a deposits outflow of $20 million with a required reserve ratio on deposits of 10%, does the bank has enough reserves to meet the reserve requirement?

   Solution.
   When there ia a deposit outflow of $20 million, the bank deposits and bank reserves decline by $20 million.
   Deposits declined from $500 million to $480 million (500 - 20) and reserves declined from $75 to $55 million (75-20).
   With $480 million of deposits, the bank is required to hold $48 million of reserves.
   The bank has $55 million of reserves, which is more than than the required reserves of $48 million.
   Therefore, the bank has enough reserves to meet the reserve requirement.

   (b) If the bank suffers a deposits outflow of $50 million (in stead of $20 million in question a) with a required reserve ratio on deposits of 10%, does the bank have enough reserves to meet the reserve requirement?

   Solution.

   When there ia a deposit outflow of $50 million, the bank deposits and bank reserves decline by $50 million.
   Deposits declined from $500 million to $450 million (500 - 50) and reserves declined from $75 to $25 million (75-50).
   With $450 million of deposits, the bank is required to hold $45 million of reserves.
   The bank has $25 million of reserves, which is less than than the required reserves of $45 million.
   Therefore, the bank does not have enough reserves to meet the reserve requirement.

2. Suppose that you are the manager of a bank whose $75 million of asset have an average modified duration of 4, while its $75 million of liabilities have an average modified duration of 6. Conduct a duration analysis for the bank and show what will happen to the net worth of the bank if interest rate rise by 3%.

   Solution.

   Percent change in market value of security = - percent change in interest rate $\times$ modified duration
   As the interest rate rise by 3%, the market value of the bank's asset falls by 12% = (3 $\times$ 4).
   The bank's asset declines from $75 million to $66 million (75 - 12%(75)).
   As the interest rate rise by 3%, the market value of the bank's liability falls by 18% = (3 $\times$ 6).
   The bank's liabilities delines from $75 million to $61.5 = (75-18%(75)).
   The net result is that the net worth (the market value of asset minus the liabilities) is increased by $4.5 million.

3. Suppose that you are the manager of a bank that has $15 million of fixed-rate assets, $30 million of rate-sensitive assets, $25 million of fixed rate liabilities and $20 million of rate-sensitive liabilities.

Conduct a gap analysis for the bank, and show what will happen to bank profits if interest rate rises by 3%.

Solution.

Suppose that interest rate rises by 3%. The income on asset rises by \$0.9 million (\$30 million of rate-sensitive assets $\times$ 3%).
The payments on the liabilities rise by \$0.6 million (\$20 million of rate-sensitive liabilities $\times$ 3%).
The bank's profit now rises by \$0.3 million.

The gap is equal to the amount of rate-sentitive asset minus the amount of rate-sensitive liabilities. In this case, the gap is equal to 30 -20 = \$10 million.
The gap is positive. Therefore, the bank profits will rise when the interest rate increases [by = $gap \times \Delta i = 10 \times 3\% = 10 \times 3\% = 0.3$].

4. According to the optimal reserve decision, what factor influence a bank's holding of reserves?

   Solution.

   According to the optimal reserve decision, the bank trade-off between the opportunity cost of holding reserve and expected adjustment cost of a reserve deficiency. Holding a lot of reserve, the banks will lose opportunity to invest the money and gain return, at rate r, opportunity cost of holding reserve is hence increased; however, by holding a lot of reserve, the bank can reduce the probability of reserve deficiency and expected adjustment cost of a reserve deficiency is hence decreased. The optimal reserve is therefore occurred when the total cost of holding reserve (C) is minimized.

   - The expected cost function is as follows.

$$\begin{array}{rcccc} C & = & rR & + & A \\ & = & \begin{array}{c}\text{opportunity cost of}\\ \text{holding reserve}\end{array} & + & \begin{array}{c}\text{expected adjustment}\\ \text{cost of a reserve deficiency}\end{array} \\ & = & rR & + & \int_R^\infty p(x-R)f(x)dx \end{array} \tag{1}$$

   - Minimizing the expected cost function in equation (1) with repect to R, yields

$$\frac{\partial C}{\partial R} = r - p\int_R^\infty f(x)dx = 0$$

$$\frac{r}{p} = \int_R^\infty f(x)dx$$

   - From the above condition, the bank chooses the level of reserves such that the probability of a reserve deficiency is just equal to $\frac{r}{p}$.
   - Thus, factors influence a bank's holding of reserves are
     (a) the interest on earning assets : the higher r, the lower optimal reserve. As r increases, the area to the left of the distribution increases. R^*, optimal reserves, is hence decreased.
     (b) the cost of meeting a reserve deficiency : the higher p, the higher optimal reserve. As p increases, the area to the left of the distribution decreases. R^*, optimal reserves, is hence increased.

(c) the probability distribution of deposit withdrawals: the probability distribution function of deposit withdrawal does matter for optimal reserve.

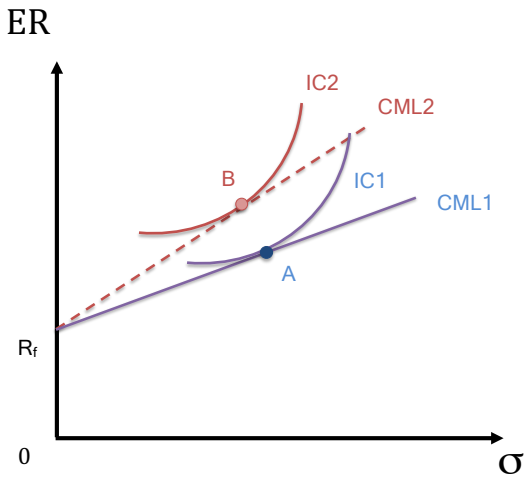
- If it is skewed to the left, the area under the graph when R is low is just a little. Large probabilty for big amount of withdrawal. Low probability for small amount of withdrawal. For the same $\frac{r}{p}$, the bank has to hold a more reserve than when the distribution is symmetric.
- If it is skewed to the right, the area under the graph when R is low is big. Large probabilty for small amount of withdrawal. Low probability for big amount of withdrawal. For the same $\frac{r}{p}$, the bank has to hold a fewer reserve than when the distribution is symmetric.

5. What does the portfolio balance model of banking predict on a bank's balance sheet if there is an increase in (a) the yield on loans and (b) the riskiness of loans?

Solution.

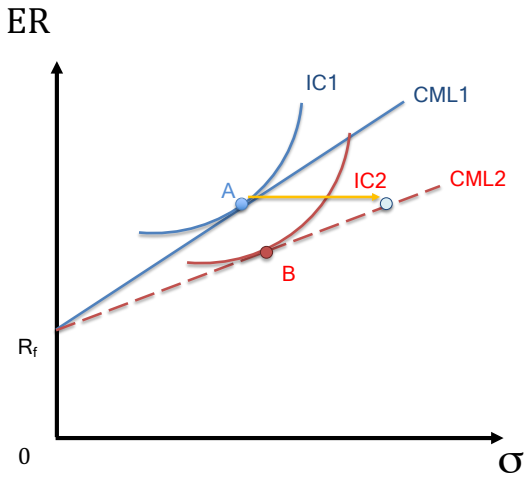
(a) an increase in the yield on loans

As the yields on loans portfolio increases, the opportunity locus shifting from CML1 to CML2. The opportunity set shifts from CML1 to CML2. As the yields on loans portfolio increases, The optimal investment is changed from point A to point B.



(b) an increase in the riskiness of loans:

As the riskiness of loans portfolio increases, the opportunity locus shifting from CML1 to CML2. The opportunity set shifts from CML1 to CML2. The optimal investment is changed from point A to point B.



6. Explain the relationship between return on assets and return on equity. What incentives does this relationship give a bank manager? Is this the desired outcome preferred by regulators? Discuss.

Solution.

$$\begin{aligned} ROE &= \frac{\text{profit after tax}}{\text{capital}} \\ &= \frac{\text{profit after tax}}{\text{asset}} \times \frac{asset}{equity} \\ &= ROA \times \text{EM} \end{aligned}$$

The return on equity (ROE) is the product of the return on asset (ROA) and equity multiplier (EM). ROA provides a measure of the profitability of assets. For any given level of ROA the bank manager can increase the profitability of the bank to its equity-holders (ROE) by increasing leverage (EM). Regulators wouldn't want this to happen because high values of EM imply high levels of risk (risk of insolvency). Bank's capital serves as a buffer against potential losses on the bank's loan investments. If bank doesn't have sufficient capital, even minor amount of defaults on its loans (which are written off against capital) can lead to bankruptcy.