1. [20 minutes] Leverage, liquidity, and bank balance sheets. If you cannot reduce to actual numbers, be sure to show your algebraic work!

1.1 (5 minutes) Consider two banks, H (high bank capital) and L (low bank capital).

<table>
<thead>
<tr>
<th></th>
<th>High Bank Capital</th>
<th>Low Bank Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>Liabilities</td>
<td>Assets</td>
</tr>
<tr>
<td>Reserves $9M</td>
<td>Deposits $90M</td>
<td>Reserves $10M</td>
</tr>
<tr>
<td>Loans $71M</td>
<td>Bank Capital $10M</td>
<td>Loans $70M</td>
</tr>
<tr>
<td>ABS $20M</td>
<td></td>
<td>ABS $20M</td>
</tr>
</tbody>
</table>

Bank capital is the equity of the owners (shareholders) of the bank. ABS stands for asset backed securities.

Calculate the return on equity (ROE) for each bank, if the rate of return on loans is 5%, and 10% on ABS, and the interest rate on deposits is 2%.

**Answer:**

For H bank:

\[
\frac{(0.05 \times 71 + 0.10 \times 20) - (0.02 \times 90)}{10} = \frac{3.75}{10} = 0.375 = 37.5\%
\]

For L bank:

\[
\frac{(0.05 \times 70 + 0.10 \times 20) - (0.02 \times 96)}{4} = \frac{3.58}{4} = 0.895 = 89.5\%
\]

1.2 (5 minutes) Show what happens to each of the bank balance sheets when the asset backed securities lose 25% of their value.

**Answer:**

The balance sheets now look like the following:

<table>
<thead>
<tr>
<th></th>
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<th>Low Bank Capital</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Liabilities</td>
<td>Assets</td>
</tr>
<tr>
<td>Reserves $9M</td>
<td>Deposits $90M</td>
<td>Reserves $10M</td>
</tr>
<tr>
<td>Loans $71M</td>
<td>Bank Capital $5M</td>
<td>Loans $70M</td>
</tr>
<tr>
<td>ABS $15M</td>
<td></td>
<td>ABS $15M</td>
</tr>
</tbody>
</table>

Bank capital is the equity of the owners (shareholders) of the bank. ABS stands for asset backed securities.

The H bank remains solvent, while the L bank become insolvent, and depositors lose $1M.
1.3 (5 minutes) Now consider two banks, one which borrows nothing short term, and one that borrows a lot on short term money markets.

<table>
<thead>
<tr>
<th></th>
<th>Bank Deposit Based</th>
<th>Money Market Based</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td><strong>Liabilities</strong></td>
<td><strong>Assets</strong></td>
</tr>
<tr>
<td>Reserves $6M</td>
<td>Deposits $60M</td>
<td>Reserves $3M</td>
</tr>
<tr>
<td>Loans $74M</td>
<td>Short term $30M</td>
<td>Loans $77M</td>
</tr>
<tr>
<td>ABS $20M</td>
<td>Bank Capital $10M</td>
<td>ABS $20M</td>
</tr>
</tbody>
</table>

Calculate the return on equity (ROE) for each bank, if the rate of return on loans is 5%, and 10% on ABS, and the interest rate on deposits is 2%, and the interest rate on short term borrowing is 1%.

**Answer:** For Deposit-based bank:

\[
\frac{(0.05 \times 74 + 0.10 \times 20) - (0.02 \times 60 + 0.01 \times 30)}{10} = \frac{4.2}{10} = 0.42 = 42\%
\]

For Money market based bank:

\[
\frac{(0.05 \times 77 + 0.10 \times 20) - (0.02 \times 30 + 0.01 \times 60)}{10} = \frac{46.5}{10} = 0.465 = 46.5\%
\]

1.4 (5 minutes) In a world without deposit insurance, which bank is more vulnerable to a “run”? Explain your answer.

**Answer:** When there is no deposit insurance, deposits are like loans with instantaneous maturity. If the short term borrowing is of longer maturity than instantaneous (that is, they have one day, or two day or more maturity), then the deposit based bank is more vulnerable to a run.

2. [20 minutes] Monetary policy.
2.1 (3 minutes) Draw a graph of the reserves market, where the demand curve takes the conventional shape, and the central bank lends freely at X%, but does not pay interest on excess reserves. Assume the equilibrium interest rate is above zero but below X% in your graph.
2.2 (3 minutes) Show what happens if the central bank increases above and beyond the point where the policy rate stops changing. Indicate the amount of quantitative easing.

The Reserve Supply curve shifts out to Res$^s$, so the equilibrium amount of reserves increases from A to C, and the equilibrium interest rate in the reserve rate drops to zero. The distance from B to C is the amount of quantitative easing, i.e., the amount of reserve increase in excess of that necessary to drop the interest rate to zero.
2.3 (4 minutes) Returning 2.1, show what happens to the equilibrium rate if the central bank pays interest of excess reserves, in excess of 0 (call it $Z\%$).

Below is drawn the case where $Z\% < i_{eqm}$

2.4 (5 minutes) Suppose the central bank purchases long term government bonds using the reserves injected in part 2.2. What happens to the interest rate long term bonds relative to short term bonds if they are perfect substitutes?

If long term bonds and short term bonds are perfect substitutes, then affecting the relative supply and demand for each type of bond cannot change the interest differential. Then the only reason the short and long term interest rates differ is because of the expected future short term interest rate is different from the current short term interest rate.

2.5 (5 minutes) Consider the central bank is trying to lower the 2 year interest rate on government bonds, and the pure expectations hypothesis of the term structure holds. If the 1 year interest rate on year in the future is 2%, and the central bank issues forward guidance such that it convinces the public that the future 1 year interest rate will be 1%. What is the immediate impact on the 2 year interest rate? Show your work.

Recall the EHTS, for a two year yield:

$$i_{2t} = \frac{1}{2}(i_{f_{t+1}} + i_t)$$

$$\Delta i_{2t} = \frac{1}{2}(\Delta i_{f_{t+1}} + \Delta i_t)$$

Notice that the change in the future interest rate shows up with a coefficient of $\frac{1}{2}$. Hence dropping the expected future 1 year rate by 1% induces a $\frac{1}{2}\%$ reduction in the 2 year yield.
3. [20 minutes] Consider a Taylor rule of the following form:

\[ i_t^{FedFunds} = \pi_t + (\pi_t - \pi_t^*) + r_t^* \]  

(1)

3.1 (5 minutes) Suppose the output gap is -6.0%, and the inflation rate is 1.0%. Calculate the central bank’s implied policy rate, assuming the equilibrium real rate of interest is 2%, and target inflation rate is 2%. Show your work.

\[ i_t^{FedFunds} = 0.01 + (0.01 - 0.02) + 0.02 \]

\[ i_t^{FedFunds} = 0.02 \]

3.2 (5 minutes) Suppose the equilibrium real rate of interest drops to 0%, but all else remains the same. How much should the central bank drop the policy rate.

\[ i_t^{FedFunds} = 0.01 + (0.01 - 0.02) + 0.00 \]

\[ i_t^{FedFunds} = 0.00 \]

3.3 (10 minutes) Suppose the government increases spending so that the equilibrium real rate of interest rises back to 2%. What should the central bank do, and what short term impact will this have on the economy? Be specific, and use an IS-LM diagram to explain the shifts.

\[ i_t^{FedFunds} = 0.01 + (0.01 - 0.02) + 0.02 \]

\[ i_t^{FedFunds} = 0.02 \]

Answer: When government spending increases, then the IS shifts out (white arrow). The central bank increases the target interest rate in response; this involves a shift up in the target effective interest rate from \( i_1 \) to \( i_2 \) (gray arrow). Depending on the slope and the shift of the IS curve, output might rise or fall.