Homework 1: Solutions
Monetary Theory and Policy: ECO 403

Question 1.

a. Checking Deposits. The bank pays no interest, but does incur small costs associated with check cashing services. The main cost is that checking deposits have a relatively high reserve requirement (3-10%). This is an opportunity cost in the sense that the bank is earning a negative interest rate on reserves rather than the positive rate it could earn by making loans.

b. Savings Deposits. Here the main cost is that the bank must pay interest on savings accounts. Most savings accounts have no reserve requirement.

c. Borrow funds from another bank. Here the cost is the interest paid to the other bank, which is the FED Funds Rate.

d. Borrow from the FED's discount window. Here there are two costs. The first is interest paid to the FED. Second, the FED regulates banks who borrow from the FED, typically by insisting that the funds are used only for low risk, low interest loans. This is an opportunity cost in that the bank must forgo more profitable (but higher risk) borrowers.

e. Borrow from the FED's TAF program. Here the opportunity cost is interest paid to the FED, but there is no regulatory scrutiny for banks that borrow from the FED using TAF.

f. Sell the loan on the Mortgage-backed securities market. By packaging loans together and selling them as a bond, the bank receives cash which can be used to make more loans. In this case, the bank typically receives a fee for creating the package and perhaps fees for collecting the mortgage checks. However, the bank incurs an opportunity cost of forgone interest payments on the loan, which now goes to the owner of the mortgage backed security.

Question 2.

Advantages include:

a. The value of a can of mackeral is close to $1, which makes mackeral easy to use as a unit of account.

b. Mackeral cans are storable.

c. Mackeral cans are small and easy to carry and exchange.

Question 3.

The TAF facility is much more precise, because the government knows that the increase in high powered money exactly equals the quantity of printed dollars auctioned, since the interest rate at the auction is set just high enough so that all funds are auctioned. In contrast, the FED is always uncertain about how many additional banks will borrow at the discount rate when it is lowered. In either case, there is uncertainty over how much the money supply will change once the high powered money enters the economy.

Question 4.

The advantage is that the interest helps keep banks from failing. Banks can keep large reserves to prevent bank runs and to pay for losses associated with mortgage loans which are not paid back and still make some interest. The disadvantage is that it discourages bank lending.

Question 5.

a. For each \$1 of deposits, $0.2 \cdot \$1 = \$0.2$ (20 cents) is kept in reserves, while the remainder (80 cents) is loaned out. Thus, using the formula for the real interest rate ($r = R - \pi$):

$$\text{ave r } = 0.8 \cdot (35 - 30) + 0.2 \cdot (0 - 30) = 4\% - 6\% = -2\% \quad (1)$$

So the bank receives a real interest rate of -2% on deposits.

b. This amounts to a very high tax on banks. The high reserve requirement forces the bank to hold money in reserve. The government ends up with printed money and the bank ends up with reserves that buy few goods. It is as if the government took money out of the banks reserves. As in this case, if reserve ratios and inflation are high enough, banks earn negative real interest. A banking crises can result where banks go out of business or have to be bailed out by the government.

Question 6.

a. Our formula is:

$$k(R) = \frac{\frac{1}{2} + 1}{\frac{1}{2} + \frac{1}{4} + \frac{1}{2} - 2 \cdot \frac{1}{8}} = \frac{3}{2} \quad (2)$$

For every \$2 in high powered money, \$3 are created through the banking system.

b. Plugging into our formula for money supply:

$$\$900 \text{ billion} = H \cdot k(R) = \frac{3}{2} H \quad (3)$$

$$\Rightarrow \quad H = \$600 \text{ billion} \quad (4)$$

c. We can use a formula from class to derive the total checking deposits.

$$M = \$900 = D\,(1 + cr) = D\left(1 + \frac{1}{2}\right) \tag{5}$$

$$\rightarrow \; D = \$600 \tag{6}$$

Once we have D, it is easy to find C:

$$cr = \frac{C}{D} \;\Rightarrow\; \frac{1}{2} = \frac{C}{\$600} \;\Rightarrow\; C = \$300 \tag{7}$$

The remaining high powered money is held as bank reserves:

$$H = C + TR \;\Rightarrow\; \$600 = \$300 + TR \;\Rightarrow\; TR = \$300 \tag{8}$$

d. The FED buys tbills to increase the money supply. The change in the money supply that is desired is $\$1200 - \$900 = \$300$. Hence:

$$\$300 = \Delta H \frac{3}{2} \;\Rightarrow\; \Delta H = \$200 \tag{9}$$

The FED would have to buy \$200 worth of tbills.

e. Plugging in as in part (a) gives:

$$k\,(R) = \frac{\frac{1}{2} + 1}{\frac{1}{2} + \frac{1}{4} + \frac{5}{2} - 2 \cdot \frac{1}{8}} = \frac{1}{2} \tag{10}$$

The money multiplier plummets as bank reserves rise. Next using the equations in class:

$$H = D\,(cr + rrr + e\,(R)) \;\Rightarrow\; \$600 \text{ billion} = D\left(\frac{1}{2} + \frac{1}{4} + \frac{5}{2} - 2 \cdot \frac{1}{8}\right) \tag{11}$$

$$\Rightarrow\; D = \$200 \text{ billion} \tag{12}$$

$$cr = \frac{C}{D} \;\Rightarrow\; \frac{1}{2} = \frac{C}{\$200} \;\Rightarrow\; C = \$100 \tag{13}$$

$$H = C + TR \;\Rightarrow\; \$600 = \$100 + TR \;\Rightarrow\; TR = \$500 \tag{14}$$

f. We have:

$$M = k(R)\,H = \frac{1}{2}\$600 \text{ billion} = \$300 \text{ billion} \tag{15}$$

g. The TAF and an open market operation work in an identical fashion here: both increase H. The FED generally prefers an open market operation, which is less costly. Using TAF might be advantagous if the FED wanted to increase reserves of institutions which do not take deposits. With an open market operation, the cash will eventually move to deposits. The TAF gives investment banks access to the printed money. In addition TAF funds are more temporary, since the printed money is removed when the loans come due. Hence TAF might be better for a temporary increase in M. We did not discuss changing the fed funds rate, but I will argue below that lowering the FED funds rate to zero will not have the desired increase in M.

h. For either TAF or buying tbills, we have an increase in H. We have:

$$\Delta M = k(R)\,\Delta H \tag{16}$$

The money supply fell from \$900 to \$300, so:

$$(\$900 - \$300) = \frac{1}{2}\Delta H \;\Rightarrow\; \Delta H = \$1200 \tag{17}$$

The FED must inject large amounts of high powered money to offset the money supply removed from the economy when the banks increased reserves.

Suppose we were to instead lower R to zero. Then:

$$k(R) = \frac{\frac{1}{2} + 1}{\frac{1}{2} + \frac{1}{4} + \frac{5}{2} - 2 \cdot 0} = \frac{6}{13} \tag{18}$$

In this case:

$$M = k(R)\,H = \frac{6}{13} \cdot \$600 \tag{19}$$

So even if the FED lowers the FED funds rate to zero, the money supply will barely change. This illustrates the difficulty of making large changes in the money supply by altering the FED funds rate, especially when it is near zero.

Question 7 .

a. The trick is to realize that non-borrowed reserves plus borrowed reserves must equal total reserves: $NBR + BR = TR$. Thus:

$$BR = 5(R - d)(NBR + BR) \tag{20}$$

$$BR = 5\,(0.12 - 0.1)\,(81 + BR) \tag{21}$$

$$BR = 8.1 + 0.1BR \quad \rightarrow \quad BR = \$9 \text{ billion} \tag{22}$$

$$TR = NBR + BR = 81 + 9 = \$90 \text{ billion} \tag{23}$$

b. Here we recognize that total reserves equal required reserves plus excess reserves (XR): $TR = RR + XR$. Thus:

$$90 = 81 + XR \quad \rightarrow \quad XR = \$9 \text{ billion} \tag{24}$$

c. From part (A), borrowed reserves are now:

$$BR = 5\,(0.12 - 0.08)\,90 \quad \rightarrow \quad BR = \$18 \text{ billion} \tag{25}$$

lp Borrowed reserves rise from \$9 billion to \$18 billion, an increase of \$9 billion. Because banks are borrowing printed dollars from the FED, and since total reserves are constant, an additional \$9 billion of high powered money enters the economy, increasing the money supply by $9 \cdot 2 = \$18$ billion.