

Homework 1: Solutions  
Monetary Theory and Policy: ECO 403

**Question 1.**

Neither. The repo account at the investment bank does not create any additional money. The investment bank “buys” a tbill from a corporation such as Apple. This opens the repo account (the next day the bank will buy back the tbill at a slightly higher price, and we call the profits earned by Apple interest). The investment bank then loans out the proceeds of the sale. The proceeds thus remain in the economy, but we already count this in M1 as currency. Since the repo account has no check writing, it is not available to be spent. Therefore the balance of the repo account does not count as M1 or M2.

**Question 2.**

- a. The FED funds rate should be greater than the reserve rate. Loaning money to another bank is slightly more risky than depositing the money in an interest bearing account at the FED, which is essentially loaning money to the FED. To compensate for the higher risk, banks that borrow must offer a higher rate.
- b. The article states that banks were inexperienced with the new system.
- c. Government banks and foreign banks do not receive interest on reserves. So for them the FED funds rate is greater than the reserve rate and there is no puzzle. If private banks do not loan to other banks and use only deposits at the FED, then reserve rate can be above the FED funds rate.

**Question 3.**

- a. We have:
  - Banks keep more money in reserve, which is not available to be spent. The money supply falls.
  - Banks keep more money in reserve, which is not available to be spent. The money supply falls.
  - The FED lends out printed money, so the money supply rises.
  - The FED conducts two open market operations. Buying long term bonds with printed money increases the money supply and selling short term tbills decreases the money supply. Since the dollar amounts are equal, the money supply is unchanged.
  - The FED buys foreign currency with printed dollars. The money supply increases.
- b. The article states that the FED plans to increase the reserve rate.

c. We have:

- Not precise. Since banks are currently holding large excess reserves, it is not clear how banks would react if the FED says more reserves are *required*. The banks could do nothing for example, since they already have more than enough reserves to satisfy even a large increase in the required reserve ratio.
- Not precise. How much extra reserves will banks add if the reserve rate increases? Since the FED relies on actions by banks with this method, the addition to the money supply is unclear.
- Precise. If the FED wants \$10 of printed money to enter the economy, it need only auction \$10. The auction will lower the interest rate until some bank borrows the \$10.
- Precise (or not applicable). By buying and selling equal dollar amounts, the FED knows the money supply will not accidentally increase or decrease.
- Precise. If the FED wants exactly \$10 to enter the economy, it needs only to buy \$10 worth of foreign currency.

#### Question 4.

- a. The FED must keep  $rrr = 0.1$  fraction of deposits in reserve at the FED. These deposits earn the reserve rate of  $R_0 = 0.25$ . The rest the bank may loan out, earning the lending rate. The bank does not pay interest on checking accounts. So the average net interest rate is:

$$\text{ave nominal net interest rate} = 4 \cdot (1 - 0.1) + 0.25 \cdot 0.1 - 0 = 3.625\%. \quad (1)$$

The real interest rate is thus:

$$\text{ave real rate} = R - \pi = 3.625\% - 3.0\% = 0.625\%. \quad (2)$$

- b. Savings deposits have no required reserves and depositors are paid an interest rate of 0.21%, so:

$$\text{ave nominal net interest rate} = 4.0 \cdot (1 - 0) + 0.25 \cdot 0 - 0.21 = 3.79\%. \quad (3)$$

$$\text{ave real rate} = 3.79\% - 3.0\% = 0.79\%. \quad (4)$$

- c. Banks can borrow from other banks at the FED funds rate of 0.13%. No reserves are required.

$$\text{ave nominal net interest rate} = 4.0 - 0.13 = 3.87\%. \quad (5)$$

$$\text{ave real rate} = 3.87\% - 3.0\% = 0.87\%. \quad (6)$$

d. Banks can borrow from the FED at the discount rate. No reserves are required:

$$\text{ave nominal net interest rate} = 4.0 - 0.75 = 3.25\%. \quad (7)$$

$$\text{ave real rate} = 3.25\% - 3.0\% = 0.25\%. \quad (8)$$

e. The ranking is (1) Borrow from banks, (2) Savings deposits, (3) Checking deposits, and (4) Discount rate. As expected, the discount rate is a last resort. Borrowing on the FED funds market looks good, but may not be a feasible option for many banks as there is little lending right now in the FED funds market since banks can earn more by parking reserves at the FED. Typically, checking deposits are usually slightly better, but usually they are close, as is the case here.

### Question 5

a. Our formula for the money multiplier is:

$$k(R) = \frac{cr + 1}{cr + rrr + e(R - R_0)} \quad (9)$$

The excess reserve ratio is:

$$e(R) = \frac{1}{3} - \frac{1}{12}(4 - 2) = \frac{1}{3} - \frac{1}{6} = \frac{1}{6}. \quad (10)$$

Substituting in the formula for  $e$  given in the problem gives:

$$k(R) = \frac{cr + 1}{cr + rrr + \frac{1}{6}} \quad (11)$$

Now we can just plug in the numbers:

$$k(R) = \frac{\frac{1}{3} + 1}{\frac{1}{3} + \frac{1}{6} + \frac{1}{6}} = 2 \quad (12)$$

For every \$1 in high powered money, \$2 are created through the banking system.

b. Plugging into our formula for money supply:

$$\$12 = M = H \cdot k(R) = 2H \quad (13)$$

$$\Rightarrow H = \$6 \text{ trillion} \quad (14)$$

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

$$M = \$12 = D(1 + cr) = D\left(1 + \frac{1}{3}\right) \quad (15)$$

$$\rightarrow D = \$9 \text{ trillion} \quad (16)$$

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

$$cr = \frac{C}{D} \Rightarrow \frac{1}{3} = \frac{C}{\$9} \Rightarrow C = \$3 \text{ trillion} \quad (17)$$

The remaining high powered money is held as bank reserves:

$$H = C + TR \Rightarrow \$6 = \$3 + TR \Rightarrow TR = \$3 \text{ trillion} \quad (18)$$

d. For required reserves, we can use:

$$rrr = \frac{RR}{D} \rightarrow \frac{1}{6} = \frac{RR}{\$9} \rightarrow RR = \$1.5 \quad (19)$$

The rest of the reserves are excess:

$$TR = RR + ER \rightarrow \$3 = \$1.5 + ER \rightarrow ER = \$1.5 \quad (20)$$

For loans, we can use:

$$\text{lending} = (1 - rd) D \quad (21)$$

Note that:

$$rd = rrr + e(R - R_0) = \frac{1}{6} + \frac{1}{6} = \frac{1}{3} \quad (22)$$

One of every three dollars deposited is kept as either excess or required reserves, the rest is lent:

$$\text{lending} = \left(1 - \frac{1}{3}\right) \$9 = \$6 \quad (23)$$

e. The FED sells tbills to decrease the money supply. The change in the money supply

that is desired is  $\$8 - \$12 = -\$4$  trillion. Hence:

$$-\$4 = \Delta M = k(R) \Delta H = 2 \cdot \Delta H \Rightarrow \Delta H = -\$2 \text{ trillion} \quad (24)$$

The FED would have to sell only  $\$2$  trillion worth of tbills. Less money cycling through the banking system would further reduce deposits so that the money supply falls by  $\$4$  trillion.

- f. The reserve to deposit ratio is unchanged since  $rd = rrr + e(R - R_0)$  and  $R$ ,  $rrr$ , and  $R_0$  are unchanged. Deposits will change, however. We have:

$$M = (cr + 1) D, \quad (25)$$

where  $M$  is the new  $M$ :

$$\text{new } M = \text{old } M + \Delta M, \quad (26)$$

$$\text{new } M = 12 - 4 = 8. \quad (27)$$

So deposits are now:

$$8 = \left(\frac{1}{3} + 1\right) D \rightarrow D = 6. \quad (28)$$

Lending is then:

$$\text{lending} = (1 - rd) D = \left(1 - \frac{1}{3}\right) 6 = 4. \quad (29)$$

Lending falls from  $\$6$  trillion to  $\$4$  trillion.

- g. Plugging in as in part (d) gives:

$$e(R - R_0) = \frac{1}{3} - \frac{1}{12}(R - R_0) = \frac{1}{3} - \frac{1}{12}(4 - 4) = \frac{1}{3}. \quad (30)$$

$$rd = rrr + e(R - R_0) = rrr + \frac{1}{3}, \quad (31)$$

$$rd = \frac{1}{6} + \frac{1}{3} = \frac{1}{2}. \quad (32)$$

The banks increase reserves relative to deposits to take advantage of the higher interest rate on reserves.

h. For deposits,  $H$  is unchanged so we can use:

$$H = (cr + rd) D, \quad (33)$$

$$6 = \left(\frac{1}{3} + \frac{1}{2}\right) D \rightarrow D = \frac{36}{5} = 7.2. \quad (34)$$

Lending is therefore:

$$\text{lending} = (1 - rd) D = \left(1 - \frac{1}{2}\right) 7.2 = 3.6. \quad (35)$$

i. We have:

$$M = \frac{cr + 1}{cr + rd} H = \frac{\frac{1}{3} + 1}{\frac{1}{3} + \frac{1}{2}} 6 = 9.6. \quad (36)$$

j. Lending declined from 6 to 3.1. In fact, lending decreased much more than when  $H$  fell. In that case lending declined to only 4. So by increasing the reserve rate, the money supply fell by less and yet lending declined more! This is a problem with increasing the reserve rate, it tend to decrease bank lending. However, raising the reserve rate does make more profits for banks. Further, banks are more stable with more profits and more reserves. So clearly, the FED must still be worried about the bad bank mortgage loans.

## Question 6

a. We have for excess reserves:

$$TR = \$1,078 = RR + ER = \$71 + ER \rightarrow ER = \$1,007 \text{ Billion}. \quad (37)$$

For deposits, we can use:

$$rrr = 0.1 = \frac{RR}{D} = \frac{\$71}{D} \rightarrow D = \$710 \text{ Billion}. \quad (38)$$

For currency in circulation, we use:

$$H = \$2,016 = C + TR = C + \$1,078 \rightarrow C = \$938 \text{ Billion}. \quad (39)$$

Obviously, the current situation is highly unusual with banks holding vast amounts of excess reserves, and households actually holding more currency than deposits.

b. For the currency to deposit ratio, we have:

$$cr = \frac{C}{D} = \frac{\$938}{\$710} = 1.32. \quad (40)$$

In more typical times,  $cr$  is less than one. Now for the excess reserve ratio:

$$e(R - R_0) = \frac{ER}{D} = \frac{\$1,007}{\$710} = 1.42. \quad (41)$$

Banks are actually holding more excess reserves than deposits.

c. We can use:

$$M = C + D = \$938 + \$710 = \$1,648 \text{ Billion}. \quad (42)$$