Money and Banking: Assignment 3 (with Solution)

1. (General Model of Deposit Creation) (40 pts) In this question, you are required to describe the changes in the balance sheets for a general deposit-creation model. Suppose an occurrence of the Fed's open market purchase proceed as follows:

   1. The Fed decided to purchase $200 millions of securities from Bank A.

   2. Bank A holds 10% of its increase in liquidity as required reserves, 40% as excess reserves, and use 50% as loans to Borrower A.

   3. Borrower A holds 50% of her liquidity as currency and 50% as deposits in Bank B.

   4. Bank B holds 10% of its increase in liquidity as required reserves, 40% as excess reserves, and use 50% as loans to Borrower B.

   5. Borrower B holds 50% of her liquidity as currency and 50% as deposits in Bank C.

   6. Finally, Bank C holds all of its increase in liquidity as reserves (required reserves plus excess reserves). Hence the deposit creation process stops here.

   Notice that the required reserve ratio, r, the excess reserve ratio, e, and the currency ratio, c, are the same for all the banks and borrowers, and are given by $r = 0.1$, $e = 0.4$, and $c = 1.0$. Answer the following questions.

   (a) (10 pts) The following balance sheet records the changes in compositions of assets and liabilities for each market participants. Fill the numbers in *a-i*.

Fed

Assets	Liabilities
Securities +$200 million	Currency+Reserves +$___ million

Bank A

Assets	Liabilities
Securities −$200 million	
Required reserves +$ a million	
Excess reserves +$ b million	
Loans + $100 million	

Borrower A

Assets	Liabilities
Currency +$ c million	Borrowing +$100 million
Deposits +$ d million	

Bank B

Assets	Liabilities
Required reserves +$ e million	Deposits +$ d million
Excess reserves +$ f million	
Loans +$ g million	

Borrower B

Assets	Liabilities
Currency +$ h million	Borrowing +$ g million
Deposit +$ i million	

Bank C

Assets	Liabilities
Reserves +$ i million	Deposits +$ i million

The answers are

$$a = 20$$

$$b = 80$$

$$c = 50$$

$$d = 50$$

$$e = 5$$

$$f = 20$$

$$g = 25$$

$$h = 12.5$$

$$i = 12.5$$

(b) (5 pts) By computing the increase in currency and reserves, confirm that the increase in monetary base is \$200 million and thus the Fed balance sheet balances.

$$a + b + c + e + f + h + i = 20 + 80 + 50 + 5 + 20 + 12.5 + 12.5$$

$$= 200$$

(c) (5 pts) Next compute the increase in money supply.

$$\text{increase in money supply} + d + i = 200 + 50 + 12.5$$

$$= 262.5$$

(d) (10 pts) By dividing the increase of money supply by the increase in monetary base, compute the money multiplier in this example.

$$\frac{262.5}{200} = 1.3125$$

$$\approx 1.31$$

(e) (10 pts) Using the ratios $r = 0.1$, $e = 0.4$, and $c = 1$, compute the theoretical

value of money multiplier.

$$m = \frac{1+c}{r+c+e}$$
$$= \frac{1+1}{0.1+1+0.4}$$
$$= \frac{2}{1.5}$$
$$= 1.3333\ldots$$
$$\approx 1.33$$

2. (Demand and Supply Analysis in The Market for Reserves) (60 pts) This question asks you to elaborate on demand and supply analysis in the market for reserves (liquidity).

   (a) The demand curve for reserves is derived from the trade-off of banks between lending/borrowing from the federal funds market and holding excess reserves.

      i. (10 pts) Suppose that the federal funds rate i_{ff} is above the interest rate i_{er} for excess reserves, that is, $i_{ff} > i_{er}$. Explain why in this case the demand curve is downward-sloping. The demand curve captures the trade-off between holding excess reserves and lending/borrowing in the federal funds market. If the federal funds rate is higher, then banks can gain higher interest earning by lending to other banks. Hence banks would rather use their excess liquidity for lending rather than holding those liquidity as excess reserves. This gives rise to the downward-sloping demand curve for reserves when $i_{ff} > i_{er}$.

      (The case of lower federal funds rate is similarly given: if the federal funds rate is lower, banks finds lending to other banks less attractive and would like to hold the excess liquidity as reserves rather than the funds for lending.)

4

ii. (10 pts) Suppose that the federal funds rate is below the interest rate for excess reserves, that is, $i_{ff} < i_{er}$. In this case, there is an arbitrage opportunity and banks' demand for reserves explodes to infinity. Explain why. (Hint: Note that banks can borrow liquidity at the federal funds rate i_{ff} and use the money to increase their holdings of reserves) If the federal funds rate is lower than the interest rate for excess reserves, banks can surely gain profits by lending from the federal funds market and use the lending to hold excess reserves. This drives the demand for reserves to infinity.

Since the demand for reserves goes to infinity at $i_{ff} < i_{er}$, the demand curve must be flat at $i_{ff} = i_{er}$.

(b) The supply curve for reserves is simply the amount of reserve supplied to the market. The amount of reserves consists of the two parts: nonborrowed reserves (NBR) and borrowed reserves (BR). The nonborrowed reserves is the amount of liquidity supplied by the Fed. The borrowed reserves is the amount of liquidity which banks decides to borrow from the Fed.

i. (10 pts) Suppose the federal funds rate is below the discount rate i_d, that is, $i_{ff} < i_d$. In this case, the amount of borrowed reserves must be zero. Explain why. Since the federal funds rate is lower than the discount rate, banks in need of liquidity would find borrowing through the federal funds market less costly than borrowing from the Fed. Hence the supply of borrowed reserves are zero when $i_{ff} < i_d$.

ii. (10 pts) Next consider the case in which the federal funds rate is above the discount rate, that is, $i_{ff} > i_d$. In this case, again there is an arbitrage opportunity for banks. Explain why. If the federal funds rate is above the discount rate, banks can gain profits by borrowing from the Fed and lending to other banks. This drives the amount of borrowed reserves to infinity.

From b)i, we see that the supply of reserves is equal to the amount of non-

borrowed reserves, which is kept fixed unless there is a policy intervention by the Fed. From b)ii, the supply for reserves goes to infinity at $i_{ff} > i_d$. Hence the supply curve must be flat at $i_{ff} = i_d$.

(c) Discuss how the increase in the following variables shifts demand or supply curve (or both). More explicitly, please answer whether an increase in a variable shifts a curve or not. If the curve shifts, then explain why the shift occurs and which direction the shift occurs. If the curve does not shift, then explain why the shift does not occur.

Example: An increase in reserve requirement ratio shifts the demand curve to the right and does not shift the supply curve. This increase shifts the demand curve to the right because, for any given federal funds rate, banks have to increase their reserve holdings. The supply curve does not shift because a change in reserve requirement does not change the actual amount of liquidity supplied in the market.

   i. (10 pts) Nonborrowed reserves. An increase in nonborrowed reserves shifts only the supply curve, which shifts to the right due to this change. The reason why the supply curve shifts to the right is because this change increases the supply of reserves when the federal funds rate is below the discount rate. The reason why the demand curve does not shift is that the actual increase in the nonborrowed reserves does not affect the decision making by banks.

   ii. (10 pts) Discount rate. An increase in the discount rate shifts only the supply curve up. The upward shift in the supply curve occurs because this raises the amount of the federal funds rate at which banks begin to lend from the Fed. This change in the discount rate does not shift the demand curve because the discount rate does not affect the banks' decision on the use of their excess liquidity.