Problem Set #10: MONEY AND BANKING

Preparation: Be sure to read "Money, Prices and Output" and the corrections and additions on pages 4-6 of this handout before attempting this problem set.

Readings: Econ 00/01, #37: U.S. Monetary Policy: An Introduction; #38: Alan S Blinder, "Central Banking in a Democracy;" #39, "Is the Fed Slave to a defunct Economist?"

Due: 11:00, December 1 (Friday)

Purpose: This exercise will help you to understand how monetary and fiscal policy interact in the determination of the level of output and interest rates. You will see how an increase in government spending will crowd out private investment spending unless the Fed validates the expansion by expanding the money supply. The IS-LM curve provides a link between the analysis of the multiplier and the aggregate demand curve.

Part I: Monetary Policy

Suppose the Fed has allowed the banking system to create M_s = \$50, that autonomous spending G+X-M = 50, and that Investment depends upon the rate of interest. In order to determine the level of output and interest rates we break the problem down into three steps.

Step 1: The IS (Investment=Saving) Curve (Equilibrium in the Goods Market)

Consider the following three-equation model:

(1) C = 2/3Y

(2) I = 100 - 500r (where r is the rate of interest)

(3) Y = C + I + G + X-M.

Example: Suppose that G+X-M = 50. Note that if the interest rate were 10% then investment would be I = 100 - 500×10% = 50; remembering the multiplier, you can verify that with this level of investment Y must equal 3×(50 + 50) = 300; hence C = 2/3×300 = 200

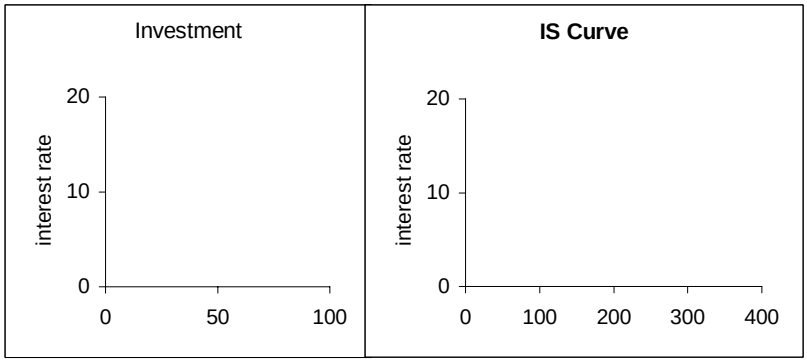
[Check: C+I+G + X-M = 200 + 50 +50 = 300].

1. Fill in the blanks on Table 1:

Table 1: IS Curve Data

r	I	Y	C
20%	0	150	100
15%	25		
10%	50	300	200
5%			

2. Plot the relationship between r and I on the first graph to the right of Table 1. (This is sometimes called the "Marginal Efficiency of Investment Schedule".) Then plot on the second graph the relationship between the rate of interest and income.



The curve plotted on the second graph, called the "IS curve", was introduced by Sir J. R. Hicks in 1937. At every point on the IS curve the *goods market* is said to be in equilibrium in the sense that the output of the economy just equals the amount that the public wants to purchase (I is determined by the Marginal Efficiency of Capital Schedule, C is determined by the consumption function, and C + I + G + X-M = Y).

Step 2: The LM curve (Liquidity demand = Money supply) Suppose that the demand for "liquidity" (i.e., money) depends upon both the level of GDP and the rate of interest. The higher GDP, given the rate of interest, the more money people will want to hold to execute transactions. Also, the public will want to cut back on its holdings of money, given GDP, if the interest rate (the cost of holding money) is high. To be specific, suppose that the demand function is

(4) $M_d = 50 + Y/2 - 1000r$.

3. To see what this implies, complete Table 2. Now recall that the Fed prompted the banking system to create a money supply of M_1 =

$50.

4. There are five rows of the table, each specifying the quantity of money people will want to hold at specified levels of r and Y. Four of these yield points of money market equilibrium where the interest rate and output are at levels where the public will be willing to hold the $50 of money the Fed has placed in circulation – i.e. four of the combinations of income and the interest rate yield a demand for money equal to the supply of $50. The other point involves an excess demand for money.

4. Plot the four points corresponding to equilibrium in the money market on the graph and connect four of them with a curve (ignore the point that corresponds to excess demand for money).

Table 2: LM Curve Data

r	Y	M_d
5%	100	50
10%	200	50
15%	300	
15%	400	
20%	400	

Sir J. R. Hicks called this the *LM relationship*. It shows those combinations of interest rate and income in which the money market could be in equilibrium in the sense that the public's demand for money would precisely equal the supply of money.

Step 3: Synthesis! For the economy to be in equilibrium, both the goods market and the money market must be in equilibrium – i.e., it is necessary to be on both the IS and the LM curve.

5. Find this happy equilibrium intersection graphically, by plotting your IS and LM curves on a sheet of graph paper for M_s = 50 and G + X –M = 50. Mark the intersection with the letter **e**. The equilibrium rate of interest is approximately ____ and the corresponding level of Y is around ____; furthermore, I is approximately ____ and C _____.

Optional: Find the equation for Y as a function of M_s and G+X-M by solving the IS and LM curves simultaneously.

6. Fiscal Policy*: Suppose* the government increases expenditures to $100, but the money supply remains stable. This action shifts the IS curve but does not affect the LM curve. Determine how far the IS curve will shift – then plot the new IS curve on your graph and determine graphically the new equilibrium level of output and the interest rate. The new level of output is approximately _____ and the interest rate is ____. Further, private investment has been cut back to _____. The expansionary fiscal policy has "crowded out" ____ of investment spending. The increase in G is substantially less than the simple multiplier would have predicted because of the crowding out of private investment.

7. Monetary Policy: Suppose the Fed engages in open market operations that lead to an increase in the money supply to $100. Explain how this will shift the LM curve. Then explain how the shift of the LM curve will change the equilibrium level of output and the interst rate. (Note that the IS curve will be unaffected by the change in the money supply.)

Step 4: Aggregate Demand Curve: The IS-LM model explains the determination of output and the interest rate, given the *real* money supply. Thus, the model is directly applicable only if the price level is stable. The Aggregate Demand Curve, easily derived from the IS-LM apparatus, helps in determining the interaction between the level of output and the price level.

8. Suppose that the Fed establishes M_1 = $100. Also, the CPI is at 100 (1992=100). Then the real value of the money supply will be 100. Determine from your IS-LM graph the resulting level of output and the interest rate.

9. Derivation of the Aggregate Demand Curve: Suppose the price level doubles (CPI=200); then the real money supply will be M_1 = $50. Determine how this reduction in the real value of the money supply will influence output by modifying your earlier calculations and

the IS-LM graph appropriately. Plot the two points on a new graph with output on the abscissa and the CPI (price level) on the ordinate. Draw a pretty curve through your two points. This is the Aggregate Demand Curve! At every point on the aggregate demand curve both the goods and the money market are in equilibrium. Does your aggregate demand curve have the expected negative slope?

10. Now suppose the CPI=100; sketch in a reasonable short run aggregate supply curve (similar to the AS curve on Figure 10.9) – make it cross the aggregated demand curve at the point where the CPI = 100.

11 Explain carefully how the Aggregate Demand Curve will shift if the level of government spending increases from 50 to 100, given the nominal money supply of $100? (Hint: First explain the shift in the IS curve). If the objective is to encourage private investment in order to maximize the future productive potential of this economy, is it better to stimulate the economy through expansionary government spending or by increasing the money supply? Explain.

Part II. Money and Banking:

Suppose the Fed sells $2 billion of government securities on the open market and that they are purchased by commercial banks. The commercial banks pay for the bonds by drawing down their deposits at the Fed.

1. Show the direct effects of this open market transaction on the balance sheets of the Federal Reserve System and of the commercial banks. Hints: Write out only the *changes* in the balance sheet (use the same general format as on Table 10.2). Note that if and only if your *changes* sum to the same figure on both sides, will the balance sheet still balance after the changes, as required.
2. What will be the effect of this transaction on the reserve posture of the commercial banks? Specifically, assuming the banks were initially "loaned up" (had no excess reserves), will they now have surplus reserves or a reserve deficiency?
3. List the alternative steps that an individual bank may take in order to cope with a reserve deficiency?
4. How will the banking system and the quantity of money in circulation in the United States be affected when the banking system has adjusted to the change in their reserve posture? (Assume that there will be no excess reserves when the adjustment process is complete.) Explain what happens.
5. Would you recommend that the Fed sell government securities on the open market when the economy suffers from inflation? Explain why or why not. [Hint: What happens to the money supply? How is the LM curve affected?]
6. Forget about the open market sale. Suppose the Fed buys $1 billion of securities the government has issued in order to finance public housing, research on Aids, and an expanded head start program. Explain carefully how this program would affect the quantity of money in circulation, taking into account both the effects of (a) the borrowing from the Fed and (b) the spending of the funds. Assume that the banking system remains loaned up.

Corrections and elaborations to Chapter 10: Money Prices and Output

Page 8: paragraph before Discount Operations – change "selling off some of their holdings of" with "purchasing". add before last sentence of same paragraph. "Banks with a reserve deficiency may reduce their lending a sell some of their holdings of government securities, or borrow from other banks or the Fed."
Page 10, next to last sentence of open market operations: replace "private credit" with "bank lending"
Page 10: Change 3 references to equation (16) to equation (24)
Page 12: Change reference to Figure 10.1 to Figure 10.7.
Page 13: Last sentence: "Substituting equation (26) into equation 4 yields…"

Table 10.1: The Money Supply

	billions of dollars				
	1960	1970	1980	1990	1999
Kinds of Money					
Currency	28.8	48.6	115.3	247.0	516.9
+ Demand Deposits	111.6	164.7	261.2	276.9	358.9
+ Other Chekable Deposits	0.0	0.1	28.1	293.7	241.4
+ Travelers checks	0.3	0.9	3.5	7.0	8.2
$= M_1$	140.7	214.4	408.1	824.6	1125.4
+ Small denomination time Deposits	12.5	151.2	728.5	1173.4	952.4
+ Savings Accounts	159.1	261.0	400.3	923.2	1738.8
+Money Market Mutual Fund Balances	0.0	0.0	63.5	358.0	846.1
$= M_2$	312.4	626.5	1600.4	3279.1	4662.7
GDP (pY)	527.4	1039.7	2795.6	5803.2	9248.4
p (GDP implicit price deflator, 1996 = 100)	22.4	29.3	57.4	86.8	104.4
Real value of the money supply					
M_1/p	6.3	7.3	7.1	9.5	10.8
M_2/p	14.0	21.4	27.9	37.8	44.7
Velocity of Money					
$v_1 = pY/M_1$	3.7	4.8	6.9	7.0	8.2
$v_2 = pY/M_2$	1.7	1.7	1.7	1.8	2.0
vc = pY/currency	18.3	21.4	24.2	23.5	17.9
currency/M_1	20.5%	22.7%	28.3%	30.0%	45.9%
currency/M_2	9.2%	7.8%	7.2%	7.5%	11.1%
M_1/M_2	45.0%	34.2%	25.5%	25.1%	24.1%

Table 10.2: Effects of a $20,000 bank loan to a car buying customer:

Step #1: The bank lends a reliable customer $20,000, placing the funds in the customer's checking account.
Step #2: The customer writes a check for $20,000 to the car dealer; the car dealer deposits the check in her bank.
Step #3: The car dealers bank sends the check for clearing through the Federal Reserve Bank

Here is how these transactions change the balance sheets of the customer, the lending bank, the car dealers bank and the Federal Reserve Bank.

Changes in Customer's Balance Sheet

Assets		Liabilities	
(#1)	ΔDemand deposit +$20,000	(#1)	ΔLoan from bank + $20,000
(#2)	ΔDemand deposit -$20,000		
(#2)	New Car! +$20,000		

Changes in Lending Bank's Balance Sheets

Assets		Liabilities	
(#1)	ΔLoans Outstanding +$20,000	(#1)	ΔDemand Deposits+ $20,000
(#3)	Deposits at the Fed -$20,000	(#3)	ΔDemand deposits -$20,000

Changes in the Car Dealer' Balance Sheet

Assets		Liabilities	
(#2)	ΔCar inventory -$20,000		
(#2)	ΔDemand Deposits +$20,00		

Changes in Car Dealer Bank's Balance Sheet

Assets		Liabilities	
(#3)	ΔDeposit at Fed + $20,000	(#3)	ΔDemand Deposits + $20,000

Changes in the Federal Reserve Bank's Balance Sheet

Assets		Liabilities	
		(#3)	ΔMember Bank Deposits
			ΔCustomer's Bank -$20,000
			ΔCar Dealer's Bank +$20,000

Note that the changes at each institution add up to zero on each balance sheet, as required for assets to remain equal to liabilities plus net worth.

The loan has led to a $20,000 increase in demand deposits; i.e., M_1 is up by $20,000. It has increased the required reserves of the car dealer's bank by $2,000 = 10% of the increase in demand deposits. It has shifted $20,000 in reserves from the lending bank to the car dealer's bank. If the Car Dealers bank was initially loaned up, it now has $18,000 = $20,000 - $2,000 of excess reserves.

How to Finance A War

King Henry VIII [1491-1547] financed his wars with France by debasing the British coinage. All the old coins had to be exchanged for new, where the new coins were obtained by melting down the old. But Henry had the Royal Mint blend lead with the reclaimed gold, which meant that for each coin exchanged for new there was an extra coin for Henry! This *seigniorage profit* was used to finance the King's expenditures, but the result was a substantial increase in the nominal money supply and inflation.

Modern governments no longer finance wars by debasing the coinage. When currency replaced gold as the primary medium of exchange, governments would resort to the printing press to finance war. But the end result may be quite similar.

> The U.S. government financed World War II at extraordinarily low rates of interest, which minimized the interest cost to the Treasury of servicing the debt. The rate on 3 month T-bills remained at only 0.375% throughout the war. The yield on long term government bonds was kept below 2.5%. The Fed kept interest rates low by purchasing government securities on the open market, which gave commercial banks the reserves they needed to expand the money supply and purchase government securities. The result was an excessive expansion of the money supply, which contributed to inflationary pressure.

Suppose a government issues $10 billion of bonds in order to finance a War, "Bonds for Peace." What will be the effect of financing government spending in this way?

Step I: Suppose, for simplicity, that all the bonds are purchased by commercial banks. Suppose also that the defense contractors (or their employees and suppliers) place the funds spent by the government on supplies in their accounts at commercial banks. Then the balance sheets of the banks will change as follows:

Changes in Commercial Bank Balance Sheets (consolidated)

(billions of dollars)

Assets		Liabilities	
ΔGovernment Bonds	+ $10billion	ΔDemand Deposits	+ $10billion

Observe that there has been an increase in the money supply of $10 billion because demand deposits count as part of the money supply. There has also been an increase in required reserves of $1, assuming that the required reserve ratio is 10%. If the commercial banks were initially "loaned up" (i.e. had no excess reserves) they will now have a reserve deficiency of $1 billion!

Step II: Suppose that the Fed (Central Bank) purchases $1 billions of government securities sold by the commercial banks, paying for them by adding $1 billion to the deposits of the banks at the Fed:

Changes in the Federal Reserve Bank Balance Sheet

(Billions of dollars)

Assets		Liabilities	
ΔGovt Bonds	+ $1 billion	ΔBank Deposits	+1 billion

Here is the combined effects of Steps I and II on the balance sheets of the commercial banks.

Changes in Commercial Bank Balance Sheets (consolidated)

(Billions of dollars)

Assets		Liabilities	
ΔGovernment Bonds	+ $9 billion	ΔDemand Deposits	+ $10 billion
ΔDeposits at the Fed	+ $1 billion		

Observation: The open market purchase by the Fed has allowed the commercial banks to increase their reserves by $1 billion, eliminating the reserve deficiency.

Morale: When modern governments finance spending by borrowing from the Central Bank, the process is much more involved than Henry VIII's practice of financing war by debasing the coinage. But either procedure results in a dramatic increase in the money supply.