

Economics 14.02
Problem Set 2 Answers
Due Date: 2/25/04

Answer each as True, False or Uncertain. Give a one or two sentence explanation for your answer.

1. To combat a recession due to slow business investment, the President of the United States should raise interest rates rather than expand defense funding. *False. The raising of interest rates will further contract investment. Moreover, the President can only influence fiscal policy. Raising or lowering interest rates is monetary policy, which is the domain of the Federal Reserve Bank.*
2. A monetary contraction cannot affect the public budget since it is not a fiscal policy. *False. A monetary contraction tends to increase the interest rate, decreasing investment and lowering equilibrium output. If government taxation is proportionate to output, total tax revenues will decline and the government's budget position will worsen.*
3. If incomes increase by \$1, aggregate demand increases by less than one dollar. *True. We typically think of an exogenous increase in investment or government spending (components of aggregate demand) producing a magnified increase in incomes through the multiplier effect. In the basic goods model of Chapter 3, a shift along the vertical demand axis produces a larger shift along the horizontal incomes axis. The statement above is the opposite way of approaching the problem; a shift in incomes on the horizontal axis produces less of a shift in aggregate demand.*
4. The equality of national income and national output is an example of an equilibrium relationship. *False. This is an identity from the National Income and Product Accounts design. Production equaling output demand is an example of an equilibrium relationship. The third type of equation employed is a behavioral equation (e.g., our consumption functions).*
5. Taxing the illegal or underground economy is not possible with either fiscal or monetary policy. *False. We have seen that the opportunity cost of holding currency is lost interest and inflation (the nominal interest rate). A large portion of United States currency is held abroad and likely used for the illegal transactions; by inflating the monetary base, the Federal Reserve Board imposes a tax on these holdings (as well as yours and mine). Of course, these types of considerations are second-order to the benefits of stable inflation for our economy.*
6. Firms often finance investment projects through retained earnings. If this was universally true, changing the interest rate would not influence investment. [When a firm makes a profit, it either pays dividends to its shareholders or retains the earnings for firm operations and investments. The expectation of the shareholders is that the investments from retained earnings will produce additional future dividends that outweigh the dividend lost in the current period.] *False. Even with investment*

financing through retained earnings, firm managers will be (should be) comparing the rates of return for investments within the firm with outside opportunities (e.g., buying government bonds). Monetary policy will still be able to influence investment through these channels.

7. A monetary action consistent with the Federal Reserve selling bonds in the open market would be an increase in the reserve ratio. *True. Selling bonds in the open market contracts the money base of the economy. Likewise, increasing the reserve ratio of banks forces them to hold higher reserves and tightens monetary environments.*

Longer Problems:

1. The Money Multiplier – Assume the public holds $c\%$ of their money in the form of currency, banks are required to hold $\square\%$ of their deposits in reserves, and the demand for money is given by:

$$M^d = \$Y * L(i) = \$Y * (0.8 - 4 * i)$$

Initially the high-powered monetary base is \$100 billion and nominal income is \$10 trillion (the latter is assumed constant throughout this problem). Let c and \square take their approximate United States values of 40% and 10%.

- a. What is the demand for central bank money?

The demand for central-bank money is the sum of currency demand by the public and reserve demand by the banking system.

$$H^d = cM^d + \square(1-c)M^d = [c + \square(1-c)] * \$Y * (0.8 - 4 * i)$$

$$H^d = [c + \square(1-c)] * \$Y * (0.8 - 4 * i)$$

$$H^d = [0.46] * \$10T * (0.8 - 4 * i)$$

$$H^d = 3.68 - 18.4i$$

- b. Find the equilibrium interest rate.

Set the demand for central-bank money equal to the supply of central-bank money (also called the high-powered monetary base):

$$0.1 = H^s = H^d = 3.68 - 18.4i$$

$$i = 19.45\%$$

- c. Write an equation relating the overall supply of money to the overall demand for money. Determine this equilibrium value. Show the two sides are equal at the interest rate you calculated in part b. Give the value of the money multiplier.

Invert the second line of the answer to part a.

$$M^s = M^d$$

$$[c + \square(1-c)]^{-1} * H^d = \$Y * (0.8 - 4 * i)$$

*The money multiplier is $0.46^{-1} = 2.17$. The overall money supply is then $2.17 * 0.1T$ or $\$0.22T$. The money demand side, with an interest rate of 19.45%, is also $\$0.22T$.*

- d. What is the impact on the interest rate if the central bank money is increased to \$500 billion? How does the public shift their relative holdings of currency, checkable deposits, and bonds?

The interest rate falls:

$$0.5 = H^s = H^d = 3.68 - 18.4i$$
$$i = 17.28\%$$

The increased supply of high-powered money requires the interest rate be lowered to spur demand for high-powered money (market clearing). At a lower interest rate consumers will demand more money, as the opportunity cost of holding money has declined. This increased demand will be proportionate for both currency and checkable deposits (the fraction c is constant); demand for bonds, on the other hand, will decline.

- e. Over the next ten years, tremendous growth in banking checkable-payment alternatives (e.g., debit cards) lowers the public's currency requirement to $c=20\%$. What happens to the interest rate (return to the case where central bank money is \$100 billion)? Explain the logic behind this result in terms of the money multiplier.

Recalculating, we see the interest rate falls as the currency requirement changes

$$H^d = [c + (1-c)] * \$Y * (0.8 - 4i)$$
$$H^d = [0.28] * \$10T * (0.8 - 4i)$$
$$0.1 = H^s = H^d = 2.24 - 11.2i$$
$$i = 19.11\%$$

The money multiplier is now higher at $0.28^{-1} = 3.57$. The public now places more of its money in checkable-deposits that the bank can re-circulate subject to the reserve requirements of the central bank. This leverages high-powered money more, requiring the interest rate to fall for money-market clearing.

- f. In part e, holding nominal GDP constant, is the velocity of money rising or falling? How does this relate to the case study on pp. 70-71? How does this affect the central bank's control of monetary policy?

In this problem, the velocity of money is falling. Nominal GDP is assumed constant, and the supply of money has increased (recall that checkable-deposits are included in the M1 definition). Thus, the number of times the money must circulate through the economy declines.

The case study illustrates a different side, particularly the rise of credit cards and other forms of financial intermediation that are not included in the money supply. Thus, a stable money supply could support a higher nominal GDP. This is technically a rising velocity of money, although thinking about credit cards will highlight that the dominant part is played by non-monetary interactions rather than a single dollar bill changing hands more often during a period time.

The Federal Reserve Board has a smaller influence on the institutions that support these non-monetary interactions than the traditional banking sector, making economic management through monetary policy more complex.

2. Closed Economy IS-LM Model – In this problem we return to a model abstracting from banks. The central bank directly controls the money supply, with real money balances set at \$1600. The government runs an unbalanced budget with expenditures of \$250 and taxes of \$200. Consumption, investment and the demand for real money balances are governed by the following behavioral relationships:

$$C = 200 + 0.25*Y_d$$

$$Y_d = Y - T$$

$$I = 150 + 0.25*Y - 1000*i$$

$$(M/P)^d = 2*Y - 8000*i$$

- a. Derive the IS relation (an equation with Y on the left side and the interest rate plus a constant on the right side).

$$Y = C + I + G$$

$$Y = 200 + 0.25*(Y-200) + 150 + 0.25*Y - 1000*i + 250$$

$$0.5*Y = 550 - 1000*i$$

$$Y = 1100 - 2000*i$$

- b. Derive the LM relation (it will be convenient for later use to rewrite this equation with the interest rate on the left side and all else on the right side).

$$(M/P)^s = (M/P)^d$$

$$1600 = 2*Y - 8000*i$$

$$Y - 800 = 4000*i$$

$$i = 0.00025*Y - 0.2$$

- c. Find the equilibrium output level.

$$Y = 1100 - 2000*[0.00025*Y - 0.2]$$

$$1.5*Y = 1500$$

$$Y = 1000$$

- d. Find the equilibrium interest rate (the LM relation is the easiest, but you can check your results with the IS curve, why?).

The IS and LM curves intersect at the equilibrium.

$$\text{IS: } 1000 = 1100 - 2000*i \Rightarrow i=0.05$$

$$\text{LM: } i = 0.00025*1000 - 0.2 = 0.05$$

$$i = 5\%$$

e. What are the values of C, I and G? Verify they add up to total income.

$C=\$400$, $I=\$350$, and $G=\$250$. $C+I+G=\$1000$.

f. Now suppose real money balances increase to $(M/P)=1840$. Solve for Y, I, C, and the interest rate. Describe in words and with a graph the effects of expansionary monetary policy. What is the absolute and relative change in consumption? investment? How does this relate to the focus of economic policy?

$$\text{IS: } Y = 1100 - 2000*i$$

$$\text{LM: } 1840 = 2*Y - 8000*i$$

$$Y - 920 = 4000*i$$

$$i = 0.00025*Y - 0.23$$

$$\text{IS: } Y = 1100 - 2000*[0.00025*Y - 0.23]$$

$$1.5*Y = 1560$$

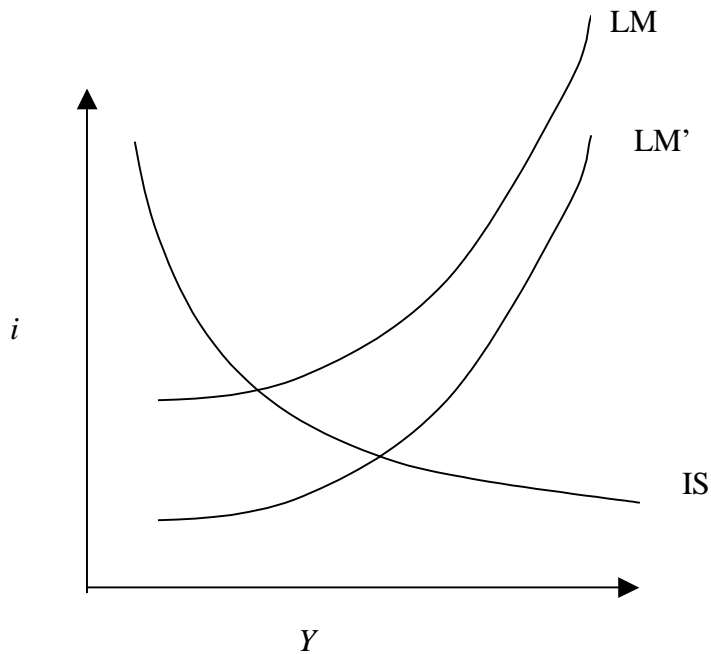
$$Y = 1040$$

$$\text{IS: } 1040 = 1100 - 2000*i \Rightarrow i=0.03$$

$$\text{LM: } i = 0.00025*1040 - 0.23 = 0.03$$

$$i = 3\%, C=\$410, I=\$380, G=\$250$$

The expansionary policy produces a \$10 (2.5%) increase in consumption and a \$30 (8.6%) increase in investment. While this example is contrived, investment swings do contribute disproportionately to business cycle fluctuations relative to investment's share of GDP (recall consumption accounts for 69% of GDP versus 17% for investment), and are thus the focus of many policy actions. The LM curve shifts down to LM', leading to a decrease in i and an increase in Y.



- g. Set $(M/P)=1600$ again. Now suppose government spending increase to $G=400$. Summarize and illustrate with a graph the effect of fiscal policy on Y , I , C , and the interest rate. Contrast the consumption response to that in part f, explaining why one is higher than the other.

$$\text{IS: } Y = 200 + 0.25*(Y-200) + 150 + 0.25*Y - 1000*i + 400$$

$$Y = 1400 - 2000*i$$

$$\text{LM: } i = 0.00025*Y - 0.2$$

$$\text{IS: } Y = 1400 - 2000*[0.00025*Y - 0.2]$$

$$1.5*Y = 1800$$

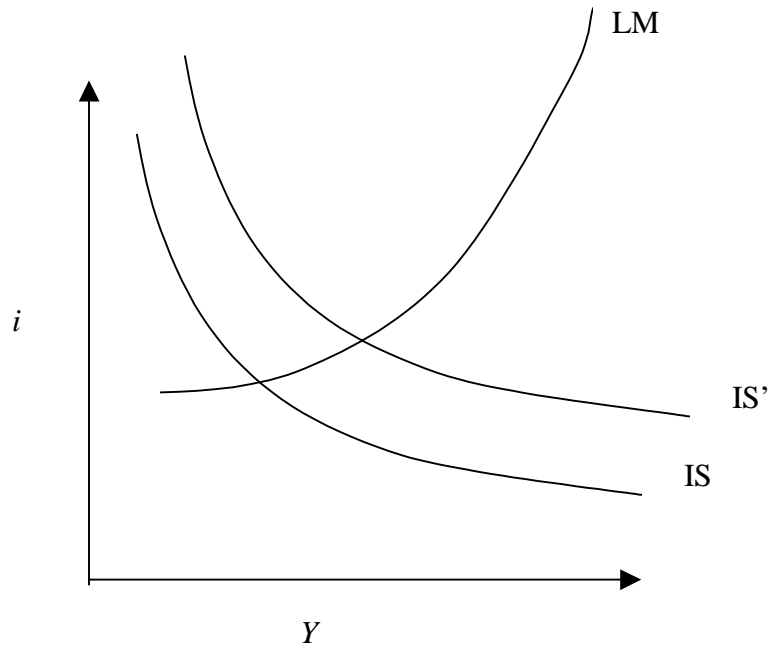
$$Y = 1200$$

$$\text{IS: } 1200 = 1400 - 2000*i \Rightarrow i=0.10$$

$$\text{LM: } i = 0.00025*1200 - 0.2 = 0.10$$

$$i = 10\%, C=\$450, I=\$350, G=\$400$$

Consumption grows by more in part g than in part f because the change in the consumers' disposable income is larger. Investment falls in the current example due to the crowding-out effect, where high government demand raises the interest rate and thus lowers private sector investment. The IS curve shifts out to IS'. In the new equilibrium, both i and Y are higher.



- h. Now implement both changes simultaneously: $(M/P)=1840$, $G=\$400$. Solve for Y , I , C , and the interest rate. Describe in words and with a graph the combined effects of expansionary monetary and fiscal policy.

$$\text{IS: } Y = 1400 - 2000 \cdot i$$

$$\text{LM: } i = 0.00025 \cdot Y - 0.23$$

$$\text{IS: } Y = 1400 - 2000 \cdot [0.00025 \cdot Y - 0.23]$$

$$1.5 \cdot Y = 1860$$

$$Y = 1240$$

$$\text{IS: } 1240 = 1400 - 2000 \cdot i \Rightarrow i = 0.08$$

$$\text{LM: } i = 0.00025 \cdot 1240 - 0.23 = 0.08$$

$$i = 8\%, C = \$460, I = \$380, G = \$400$$

The combined output response is the largest, as the lower interest rate (relative to the fiscal policy example) keeps a higher investment level. The monetary authority has accommodated the fiscal expansion by increasing the money supply, thus keeping the interest rate lower so that investment is not crowded out. The IS curve shifts out and the LM curve shifts down. Both of these lead to higher output in the new equilibrium. And while the effect on the interest rate is ambiguous in general, the fiscal policy dominates here, and pushes i up more than the monetary policy pushes it down.

