

PROBLEM SET 2
14.02 Macroeconomics
March 6, 2006

I. Answer each as True, False, or Uncertain, and explain your choice.

1. The IS relation is a behavioral relation, telling us how the suppliers of output respond to changes in the interest rate.

Ans:

False. Every point on the IS curve represents a possible goods market equilibrium, so the IS relation refers to the equilibrium condition of a goods market under an exogenously given fiscal policy.

2. In an expansionary open market operation, the central bank sells bonds so as to make consumers wealthier.

Ans:

False. In an expansionary open market operation, the central bank increases money supply by buying bonds but not selling bonds. Purchases or sells of bonds by the Fed change consumers' relative holdings of bonds vs. money, and thus the instantaneous effect of an OMO is only on the composition of consumers' wealth.

3. Expanding government spending leaves less saving available for private investment, so investment necessarily decreases. This is known as the crowding-out effect of fiscal expansion.

Ans:

Uncertain. A fiscal expansion increases both output and the interest rate. Investment increases with output but decreases with interest rate, so the net effect of increasing G on I is ambiguous.

4. In the last 40 years, the ratio of money to nominal income and the interest rate have moved in opposite directions.

Ans:

False. See Figure 1 on page 70. The interest rate was significantly lower in 2003 than it was in the 1960s. One would therefore have expected the ratio of money to nominal income to be higher. Yet, in 2003, the ratio was less than half what it was in 1960. There has been a large decline in the ratio of money to nominal income since 1960. Think about what is missing in the textbook specification of money.

5. Since the Fed can change the federal funds rate when it wants, monetary policy works almost instantly.

Ans:

False. Although the short-term interest rate adjusts immediately, it takes nearly 2 years for monetary policy to have its full effect on output. There are lags in the adjustment of investment by firms following a change in the interest rate, and then further lags in the adjustment of output and successive rounds of feedback adjustment.

II. Short Questions

1. Consumption, investment, and the recession of 2001

Examine the movements of consumption, investment and the response of monetary policy before, during and after the recession of 2001.

- a. Download the 2005 *Economic Report of the President* from the 14.02 course website. Now track consumption and investment around 2000 and 2001. Table B-4 in the statistical appendix shows the percentage change in real GDP and its components. Which variable, gross private consumption or private nonresidential investment, had the bigger percentage change in year 2001? Table B-5 weighs the percentage change of the components of GDP by their size and shows the contribution of each component to the overall percentage change in real GDP. Calculate the change in the contribution of each variable for 2001 (i.e. subtract the contribution of gross private consumption in 2000 from that in 2001, and do the same for private nonresidential investment). Which variable had the bigger fall in contribution to growth? What do you think was the proximate cause of the recession of 2001? (A fall in investment demand or a fall in consumption demand?)

Ans:

In year 2001, gross private consumption grew by 2.5%, and private nonresidential investment fell by 4.2%. The latter had the bigger percentage change. Moreover, private nonresidential investment had a bigger fall in contribution to growth, -1.58% compared to -1.43% for consumption. The numbers suggest that what triggered the 2001 recession was not a fall in consumption demand, but a sharp decline in investment demand. Note that consumption is much bigger than investment (check out Table B-2), so smaller percentage changes in consumption can have the same impact on GDP as much larger percentage changes in investment.

- b. The Federal Reserve Board of Governors posts the recent history of the federal funds rate at www.federalreserve.gov/fomc/fundsrate.htm. When did the Fed launch the latest monetary expansion? How long did this monetary expansion last? Can you explain why? (Hint: refer to Table B-4 of the *Economic Report of the President* for overall economic performance before, during and after the recession of 2001.)

Ans:

The Fed who observed signs of a recession stopped its contractionary policy in June 2000 and embarked on a monetary expansion in January 2001. The monetary policy stayed expansionary throughout the recession and remained accommodative after the recession, until the evidence of a solid recovery accumulated and the Fed stopped decreasing the interest rate in August 2003.

2. IS-LM

Consider the following IS-LM model:

$$\begin{aligned}
C &= c_0 + c_1(Y - T) \\
I &= b_0 + b_1Y - b_2i \\
\left(\frac{M}{P}\right)^d &= d_1Y - d_2i \\
\left(\frac{M}{P}\right)^s &= \frac{M}{P}
\end{aligned}$$

where $(b_1 + c_1) < 1$; G , T and M are constant and given exogenously.

- a. Derive the IS relation. What is the slope of the IS curve? Derive $\frac{dY}{di}$. (Note: $\frac{dY}{di}$ is not precisely the slope of the curve, since i is on the vertical axis and Y is on the horizontal axis. You should think of the IS relation as how Y is determined in the goods market for a given i .) What is the sign of the slope? Discuss what determines the steepness of the IS curve.

Ans:

Consider the goods market equilibrium ($Y = Z$),

$$\begin{aligned}
Y &= C + I + G \\
&= c_0 + c_1(Y - T) + b_0 + b_1Y - b_2i + G \\
(1 - c_1 - b_1)Y &= (c_0 + b_0) - c_1T + G - b_2i
\end{aligned}$$

\implies

$$\begin{aligned}
IS : Y &= \frac{(c_0 + b_0) - c_1T + G - b_2i}{(1 - c_1 - b_1)} \\
\frac{dY}{di} &= -\frac{b_2}{(1 - c_1 - b_1)} < 0
\end{aligned}$$

The IS curve becomes less steep as investment becomes more responsive to change in i , in other words, as b_2 increases. Moreover, the IS curve is less steep if the multiplier of the economy $\frac{1}{(1 - c_1 - b_1)}$ is larger.

- b. Derive the LM relation. What is the slope of the LM curve, i.e., $\frac{di}{dY}$? The sign of the slope? Discuss what determines the steepness of the LM curve.

Ans:

Consider the money market equilibrium $\left(\left(\frac{M}{P}\right)^s = \left(\frac{M}{P}\right)^d\right)$,

$$\frac{M}{P} = d_1Y - d_2i$$

\implies

$$\begin{aligned}
i &= \frac{d_1Y - \frac{M}{P}}{d_2} \\
\frac{di}{dY} &= \frac{d_1}{d_2} > 0
\end{aligned}$$

The LM curve becomes steeper as money demand becomes more responsive to change in aggregate economic activity, in other words, as d_1 increases. Moreover, the LM curve is steeper if money demand is less responsive to change in i , i.e., if d_2 is smaller.

- c. Now assume that money demand is independent of interest rate, i.e., a vertical LM curve,

$$\left(\frac{M}{P}\right)^d = d_1 Y$$

Solve for the equilibrium output and the equilibrium interest rate. How does output change with changes in T ?

Ans:

For the two markets to clear at the same time, set IS=LM:

$$IS : Y = \frac{(c_0 + b_0) - c_1 T + G - b_2 i}{(1 - c_1 - b_1)}$$

$$LM : \frac{M}{P} = d_1 Y$$

\Rightarrow

$$Y = \frac{1}{d_1} \frac{M}{P}$$

$$i = \frac{(c_0 + b_0) - c_1 T + G - \frac{(1 - c_1 - b_1) M}{d_1} \frac{M}{P}}{b_2}$$

Output does not respond to change in fiscal policy.

- d. Now assume that money demand is independent of output, i.e., a horizontal LM curve,

$$\left(\frac{M}{P}\right)^d = d_1 - d_2 i$$

Solve for the equilibrium output and the equilibrium interest rate. How does output change with changes in T ? Compare your answers to (c) and (d), and explain the difference.

Ans:

For the two markets to clear at the same time, set IS=LM:

$$IS : Y = \frac{(c_0 + b_0) - c_1 T + G - b_2 i}{(1 - c_1 - b_1)}$$

$$LM : \frac{M}{P} = d_1 - d_2 i$$

\Rightarrow

$$Y = \frac{(c_0 + b_0) - c_1 T + G - \frac{b_2}{d_2} \left(d_1 - \frac{M}{P}\right)}{(1 - c_1 - b_1)}$$

$$i = \frac{d_1 - \frac{M}{P}}{d_2}$$

Output falls as tax rises, $\frac{dY}{dT} = \frac{-c_1}{(1 - c_1 - b_1)}$. The slope of the LM curve determines the effectiveness of fiscal policy.

III. Long Question (Policy Mix)

Assume the economy starts at an equilibrium (Y^*, i^*) . Suggest a policy mix to achieve the following objectives:

1. Increase Y while keeping i constant.

a. Plot the IS-LM curves. Show the effects of your proposed policy mix in the IS-LM diagram, and explain.

Ans:

The right mix is an expansionary fiscal policy (increasing G or decreasing T) combined with an expansionary monetary policy. See Figure I. An expansionary fiscal policy shifts out the IS curve. Without any change in money supply, the equilibrium will move along the original LM curve to a new equilibrium with higher Y and higher i . A simultaneous expansionary monetary policy helps to ease the money market and offset the upward pressure on interest rate resulting from an increase in Y .

b. What happens to each component of aggregate output, i.e., C , I and G ?

Ans:

Equilibrium private consumption increases as a consequence of an increase in output (and a tax cut).

Equilibrium investment increases as a consequence of an increase in output. The equilibrium government spending either increases or remains unchanged depending on the mix of policy instruments (G, T) used to implement an expansionary fiscal policy.

2. Decrease the fiscal deficit while keeping Y constant.

a. Plot the IS-LM curves. Show the effects of your proposed policy mix in the IS-LM diagram, and explain.

Ans:

The right mix is a contractionary fiscal policy (decreasing G or increasing T) combined with an expansionary monetary policy. See Figure II. A contractionary fiscal policy shifts in the IS curve. Without any change in money supply, the equilibrium will move along the original LM curve to a new equilibrium with lower Y and lower i . A simultaneous expansionary monetary policy shifts down the LM curve and prevents a potential recession resulting from restoring fiscal balance. The policy mix leaves a lower interest rate in the new equilibrium.

b. What happens to each component of aggregate output, i.e., C , I and G ?

Ans:

Equilibrium private consumption and equilibrium private saving either remain unchanged if there is no change in tax policy or decreases due to an increase in tax.

Equilibrium investment increases as a result of a lower interest rate.

The change in equilibrium government spending is ambiguous depending on the mix of policy instruments (G, T) used to implement a contractionary fiscal policy.

- c. Would you recommend such a policy mix to the Japanese economy? (Hint: Check out the current short-term interest rate in Japan at the OECD website (www.oecd.org/dataoecd/55/60/18624750.pdf). Will people want to hold bonds or money if the interest rate on bonds is negative? Think about the limits of monetary policy.)

Ans:

No, such a policy mix will not be feasible for the Japanese economy. The current short-term interest rate in Japan is around three hundredth of a percent, i.e. zero for all practical purposes. A monetary expansion can hardly move the segment of LM curve that is close to zero interest rate. The inability of the central bank to decrease the interest rate further when it is already very close to zero is known as the “liquidity trap” and was first mentioned by Keynes in 1936 in his *General Theory*.

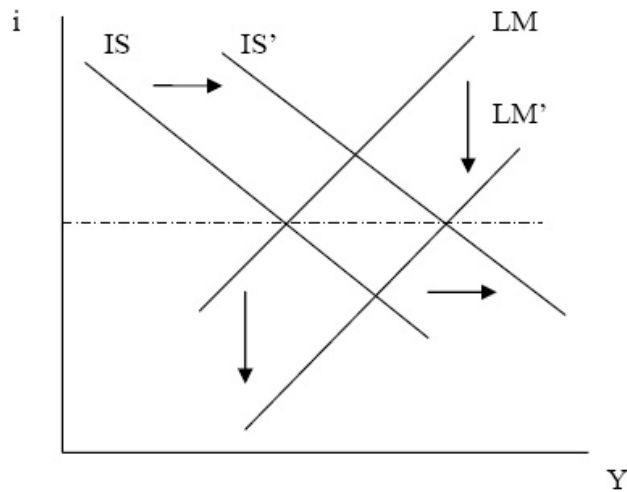


Figure I

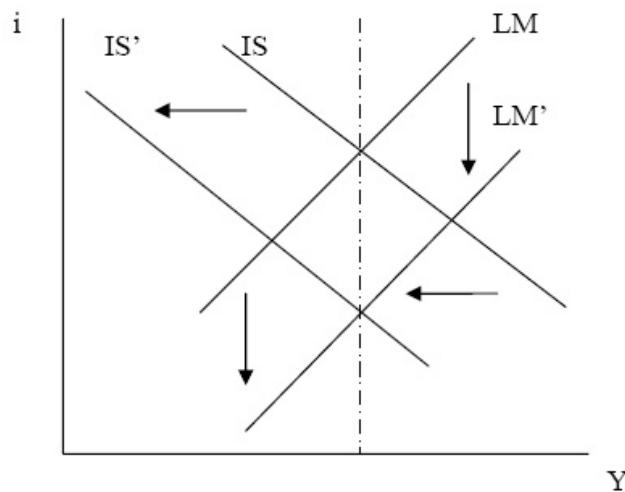


Figure II