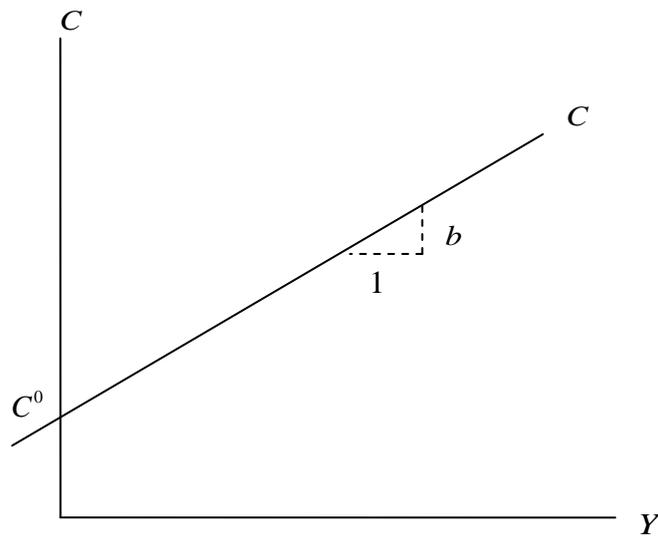


1.

a)

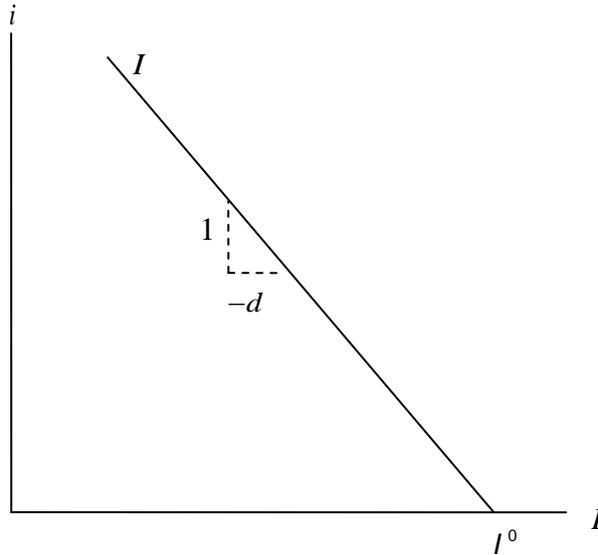


$C^0$  is the intercept of the consumption function, how much consumption will be at zero income. We can think that, at zero income, the typical consumer would consume out of his assets.

The slope  $b$  is the marginal propensity to consume which shows how sensitive consumption is to changes in income. A one unit increase in income will increase investment by  $b$  units.

We have omitted some variables, e.g. asset holdings and expected future income. We can think of changes in those variables as changing the intercept of the consumption function.

b)



$I^0$  shows what investment will be if the interest rate is zero. The parameter  $d$  shows how sensitive investment is to changes in the interest rate. A one unit increase in the interest rate will reduce investment by  $d$  units.

- c) In order to find the equilibrium level of income for a given interest rate, we substitute the consumption function and the investment function into the goods market equilibrium condition:

$$Y = C^0 + bY + I^0 - di.$$

We then collect the  $Y$ -terms on the left hand side (we subtract  $bY$  on both sides):

$$Y - bY = C^0 + I^0 - di.$$

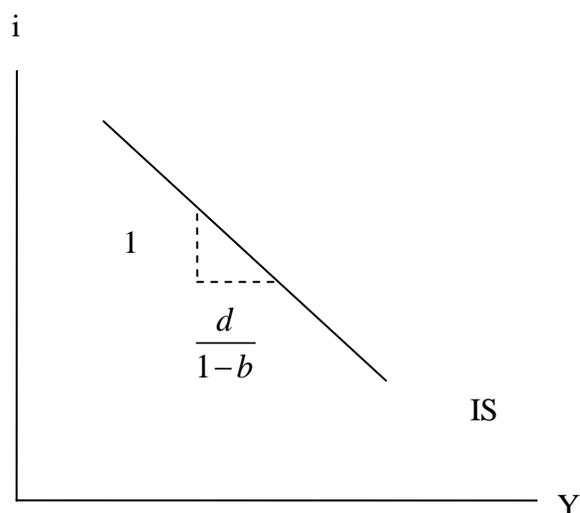
Then we rewrite the left hand side:

$$(1-b)Y = C^0 + I^0 - di.$$

Dividing by  $(1-b)$  we get the solution for  $Y$ :

$$Y = \frac{1}{1-b} [C^0 + I^0 - di].$$

This is the equation for the IS curve. We can illustrate this relation:



- d) If there is an exogenous increase in the willingness to invest represented by  $\Delta I^0$  we can find the effect on production by rewriting

$$Y = \frac{1}{1-b} C^0 + \frac{1}{1-b} I^0 - \frac{d}{1-b} i$$

and taking the derivative

$$\frac{dY}{dI^0} = \frac{1}{1-b}.$$

Provided that  $0 < b < 1$ , the total effect on production is larger than the change in investment.

- e) The effect of the interest rate is found by taking the derivative with respect to  $i$ :

$$\frac{dY}{di} = -\frac{d}{1-b}.$$

An increase in the interest rate by one unit reduces investment by  $d$  units and then we have the multiplier effect on that. The bigger the effect of interest on investment ( $d$ ) and the bigger the marginal propensity to consume ( $c$ ) the larger is the total effect on income.

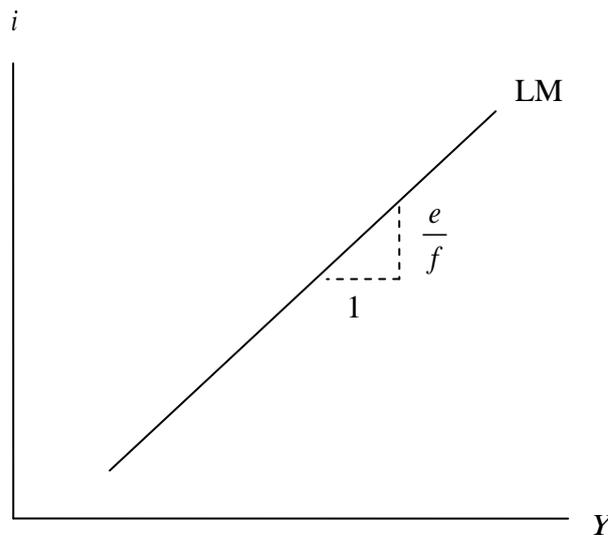
- f) In order to set the interest rate at some target level, the central bank must adjust the money supply (the monetary base) to equal demand at that interest rate. Hence the role of equation (4) is to determine the money supply.

2.

- a) If the central bank keeps the money supply constant, we must treat the interest rate as endogenous. Thus we need to use all four equations to solve for  $Y$ . To do this we first solve equation (4) for the interest rate by rewriting:

$$fi = eY - \frac{M}{P} \quad i = \frac{e}{f}Y - \frac{1}{f} \frac{M}{P}.$$

This is the equation for the LM curve. It shows that, for a given money supply, higher production leads to a higher interest rate. The reason is that higher income increases the demand for money so the interest rate has to increase to keep demand for money equal to the exogenously given supply.



Taking the derivative we get the slope of the LM curve:  $\frac{di}{dY} = \frac{e}{f}$

The coefficient  $e$  shows the effect of income on money demand and the coefficient  $f$  shows how sensitive money demand is to the interest rate. The stronger the effect of income on money demand (higher  $e$ ) the more the interest rate will increase. The more interest-sensitive money demand is (higher  $f$ ) the less the interest rate needs to increase to bring equality between demand and (given) supply of money at a higher level of production.

- b) We substitute the expression for the interest rate (the LM relation) into the investment equation:

$$I = I^0 - d \left( \frac{e}{f}Y - \frac{1}{f} \frac{M}{P} \right) = I^0 - \frac{de}{f}Y + \frac{d}{f} \frac{M}{P}.$$

Then we substitute this and the consumption function into the goods market equilibrium condition:

$$Y = C^0 + bY + I^0 - \frac{de}{f}Y + \frac{d}{f} \frac{M}{P}$$

Collecting the Y-terms on the left hand side

$$Y - bY + \frac{de}{f}Y = C^0 + I^0 + \frac{d}{f} \frac{M}{P}$$

rewriting

$$Y \left( 1 - b + \frac{de}{f} \right) = C^0 + I^0 + \frac{d}{f} \frac{M}{P}$$

And dividing by the expression in parenthesis, we get the solution for Y for a given money supply:

$$Y = \frac{1}{1 - b + \frac{de}{f}} \left( C^0 + I^0 + \frac{d}{f} \frac{M}{P} \right).$$

$$c) \quad \Delta Y = \frac{1}{1 - b + \frac{de}{f}} \Delta I^0 \quad \Leftrightarrow \quad \frac{\Delta Y}{\Delta I^0} = \frac{1}{1 - b + \frac{de}{f}}$$

d) When the interest rate is kept constant, the multiplier is  $\frac{1}{1 - b}$ . The difference

is the term  $\frac{de}{f}$  in the denominator when M is kept constant. Production

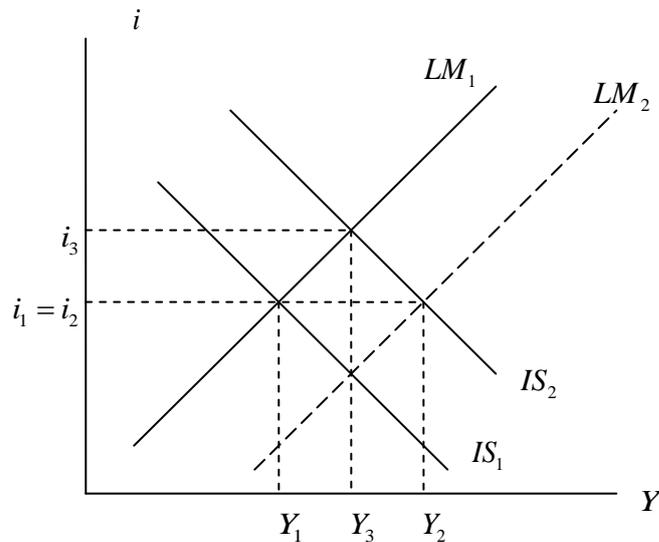
increases less when the money supply is kept constant because the interest rate increases and this has a negative effect on investment.

The exogenous increase in investment raises demand and production. An increase in production will increase the need for means of transactions. To keep the interest rate constant, the central bank must increase the supply of money. If the central bank does not increase the money supply, there will be a shortage of money and the interest rate will increase. The increase in the interest rate has a negative effect on investment and dampens the increase in production.

This is illustrated in the figure below where the original values of the variables are denoted 1, those after the shock with an unchanged interest rate are denoted 2 and those after the shock with a constant money supply are denoted 3.

The exogenous increase in investment  $\Delta I^0 > 0$  shifts the IS curve to the right. If the interest rate is kept unchanged, production increases to  $Y_2$  and the central bank must increase the money supply so the LM curve shifts to  $LM_2$ .

If the money supply is kept constant, the LM curve is unchanged, production increases from  $Y_1$  to  $Y_3$  and the interest rate from  $i_1$  to  $i_3$ .



3.

- a) Again we solve for the equilibrium level of income by the substitution method. First we substitute the tax function into the consumption function:

$$C = C^0 + b(Y + T^0 - tY).$$

Then we substitute for consumption and investment in the goods market equilibrium condition and solve for  $Y$ :

$$Y = C^0 + b(Y + T^0 - tY) + I^0 - di + G$$

$$Y = C^0 + bY + bT^0 - btY + I^0 - di + G$$

$$Y - bY + btY = C^0 + bT^0 + I^0 - di + G$$

$$Y(1 - b + bt) = C^0 + bT^0 + I^0 - di + G$$

$$Y = \frac{1}{1 - b + bt} (C^0 + bT^0 + I^0 - di + G).$$

b) 
$$\Delta Y = \frac{1}{1 - b + bt} \Delta G$$

The coefficient  $t$  is the marginal tax i.e. how much taxes increase when incomes increase one unit. A high marginal tax reduces the multiplier effect. Part of the increase in income is taxed away so the increase in consumption will be smaller and therefore the second and third round effects of the increase in demand will be smaller.

$$c) \Delta Y = \frac{b}{1-b+bt} \Delta T^0$$

An increase in  $T^0$  shifts down the tax schedule. Consumers have higher disposable income and how much they spend of that depends on  $b$ , the marginal propensity to consume. The direct effect on demand is  $b\Delta T^0$  and then we have a multiplier effect on that.

4. Let us assume that the increase in income is evenly distributed among the different types of consumers. Since 20 percent of the consumers spend everything they have they spend 20 million.

The others get 80 million of which 40 is perceived as permanent and 40 is perceived as temporary. According to our theory, they should spend the permanent part, i.e. 40 million.

According to the theory in Chapter 4, a temporary increase in income should be put in the bank and you should only consume the interest on this amount. If we assume that the real interest rate is 3 percent, the consumers will spend 3 percent of 40 million i.e. 1.2 million.

Thus the total increase in consumption will be

$20 + 40 + 0.03 \cdot 40 = 20 + 40 + 1.2 = 61.2$  million. Thus the marginal propensity to consume is about 0.6.

5. Aggregate demand is determined by

$$Y = C(Y, Y^e, r, A) + I(r, Y^e, K).$$

- a) With the new technology, firms see new investment possibilities and consumers want to replace their old cars. Thus, consumption purchases and investment will both increase and the IS curve will shift out.
- b) If the central bank keeps the money supply constant, production will increase.
- c) If production was originally on the natural level, the central bank will be worried that wages will increase so there will be high inflation. Therefore, it is likely that the central bank will raise the interest rate.