

The IS–LM model

The IS–LM model began as John Hicks’s attempt to provide a relatively simple mathematical formulation of the macroeconomic theory developed in John Maynard Keynes’s *General Theory of Employment, Interest and Money* (1936). It builds on the “multiplier model” that we have already considered at length, adding in a treatment of the “interest and money” of Keynes’s title.

1 The IS schedule or curve

The IS schedule is derived straight from the multiplier model, under the assumption that planned investment, I_p , is negatively or inversely related to the rate of interest: that is, a low rate of interest encourages investment spending and a high rate discourages it. A simple linear formulation of this idea is

$$I_p = d - er \quad d > 0, e > 0$$

Substituting this into the multiplier formula we get

$$Y = \frac{1}{1 - b(1 - t) + z} (a + d - er + G + X) \quad (1)$$

Remember that “investment” in the macroeconomic context means purchase of newly produced capital goods. For example, a manufacturing firm builds a new factory, an airline buys new aircraft, a bank installs a new computer system, a software company builds a new call center. The building of new houses is also included.

A firm that is considering a possible investment project may be in either of two positions: either it has sufficient funds to pay for the project, or it would have to borrow to finance the project. In the second case the role of the interest rate is pretty obvious: the higher the rate, the more expensive are the borrowed funds, so firms will be more choosy about the investment projects they deem worthwhile. But even in the first case the interest rate matters: it represents the *opportunity cost* of the firm’s funds—the return the firm could get simply by putting its money into, say, Treasury bonds rather than building the factory or buying the aircraft.

To get the IS “curve”, we plot the relationship between r and Y that is implied by equation (1)—see Figure 1.

The downward slope of IS reflects this chain:

$$r \downarrow \rightarrow I_p \uparrow \rightarrow Y \uparrow$$

The first link goes under the name of the *interest-elasticity of investment*, meaning the degree to which investment spending responds when the rate of interest changes. The second link, from I_p to Y , depends on the multiplier. So note, if the interest-elasticity of investment is strong and/or the multiplier is large, this will make the IS curve relatively *flat*: even a fairly small change in r will have a big effect on Y . Conversely, if investment doesn’t respond much to the interest rate or the multiplier is small, the IS curve will be relatively steep (not much effect on Y when r changes).

If you look back at equation (1) you can see what will *shift* the IS curve left or right. Anything that increases Y for a given value of r will shift IS to the right (so, an increase in a , d , G or X). Reductions in a , d , G or X will shift the curve left.

2 The “traditional” LM schedule or curve

The LM schedule represents equilibrium in the money market. This can be analysed in various ways, but the traditional approach rests on the assumption that the central bank sets the total supply or stock of money in the economy, M . In that case the rate of interest is determined in the market by forces of supply and demand.

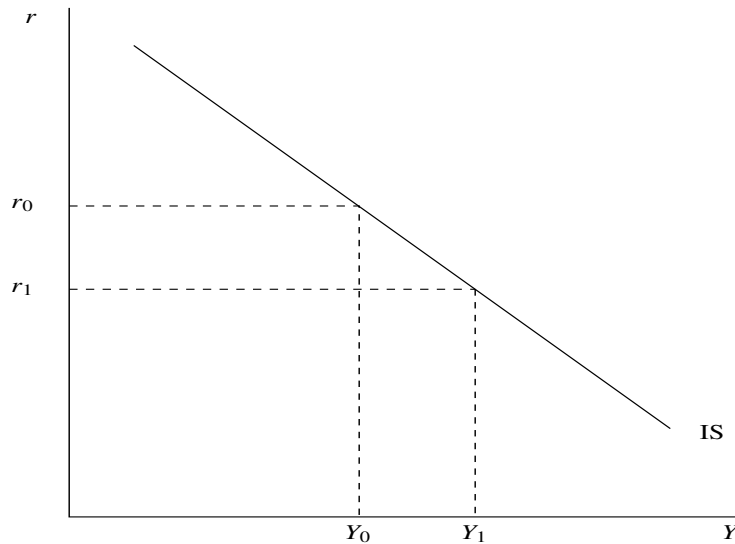


Figure 1: IS: when r falls, I_p increases and so does Y

We can write the *demand for money* as

$$M^d = P(kY - hr) \quad (2)$$

This indicates that M^d is a function of the two variables Y (real GDP) and r , multiplied by the price level, P . The k and h are parameters, stand-ins for numerical values, both positive. So Y is taken to have a positive effect on the demand for money while r has a negative effect. Let's think about this.

- Positive effect (k) of Y on M^d : A greater GDP means greater production of goods and services, more sales and more spending. The idea is that if people and firms are going to spend more, then other things equal they will wish to have more money on hand.
- Negative effect ($-h$) of r on M^d : Here we're looking at *portfolio choice*—in what form do you want to hold your wealth? Money is supremely *liquid*, but it pays either no interest (cash) or at best minimal interest (some checking accounts). “Bonds,” on the other hand, are not so liquid but pay (greater) interest. From this perspective the rate of interest is the opportunity cost of holding money—the return you're missing out on by *not* holding bonds. The higher that opportunity cost, the more incentive you have to cut back on your holding of money.
- Multiplicative effect of P : The idea here is simply that given Y and r , your holding of money should be proportional to the general level of prices. If prices were 20 percent higher, you'd want to be holding 20 percent more money, other things equal.

Monetary equilibrium requires that M^d equals the stock or supply of money, M . If we set $M^d = M$ and divide both sides by P , we get

$$\frac{M}{P} = kY - hr \quad (3)$$

For the moment, suppose P is constant (and so can be ignored). Figure 2 presents a stepping-stone towards the LM schedule. The vertical line labeled M^s represents the amount of money made available by the central bank. The downward sloping schedule labeled $M^d(Y_0)$ represents the demand for money when GDP is at Y_0 .¹ The rate of interest that equates M^d and M^s is then r_0 . Now suppose that GDP increases to Y_1 : this will shift the M^d curve upward (or rightward) to the position labeled $M^d(Y_1 > Y_0)$. Now the equilibrium interest rate will be r_1 .

The point is this: *by itself*, an increase in Y raises the demand for money. However, we're assuming the stock of money remains unchanged. In that case the quantity demanded must somehow be squashed back down to equal the given supply—and that will take an increase in r .

¹ Strictly speaking, our simple M^d equation says this should be a straight line, but the curve shown in the diagram is more realistic.

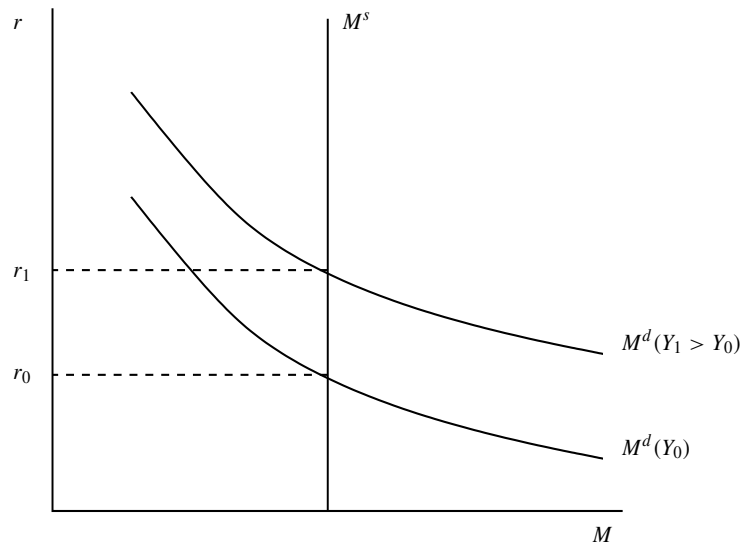


Figure 2: Money supply and money demand for two levels of Y

The LM curve proper just puts this relationship into the same “space” as the IS curve, with Y on the horizontal axis and r on the vertical, as shown in Figure 3.

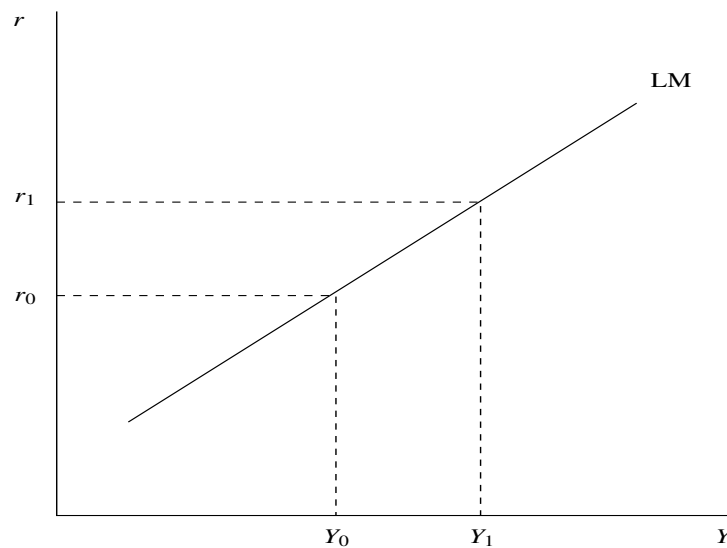


Figure 3: LM: when Y increases, M^d increases and so does r

As with the IS curve, we want to know what determines the slope of the LM curve, and what factors are capable of shifting the curve. Here it’s helpful to state the equation for LM. This is just equation (3) solved for r :

$$r = \frac{k}{h}Y - \frac{1}{h} \frac{M}{P} \quad (4)$$

- LM slope: the key factor here is the *interest-elasticity of the demand for money*, that is, the degree to which the demand for money responds to changes in the rate of interest, represented by h above. As we saw, if Y increases while M remains fixed, we require a rise in r to maintain supply/demand balance—but how big an increase in r is needed? If money demand responds strongly to changes in r (big h) then a small rise in r should be sufficient: this means LM will have a relatively shallow slope. If the response is weak, a big change in r will be needed, and the LM slope will be steep. In the limit—money demand totally unresponsive to r —the LM curve will be vertical.

- LM shifts: Look back at Figure 2. Suppose the central bank increases M^s , shifting the vertical line to the right. Then, for any given value of Y , the rate of interest would fall. In the IS–LM space, that means that the LM curve shifts down when M^s is increased (and shifts upward when M^s is reduced). This is confirmed by the negative coefficient, $-1/h$, on M/P in equation (4). From the equation we can also see that a change in P will have the opposite effect of a change in M : an increase in P will drive the LM curve upward.

3 Putting it together

Figure 4 shows IS and LM together. If we're on the IS curve, that means that the *goods market* is in equilibrium—aggregate demand equals output, firms are not experiencing an unwanted change in their inventory levels. If we're on the LM curve, that means that supply equals demand in the *money/bonds market*. So at the intersection of the two schedules we're in “general equilibrium.”

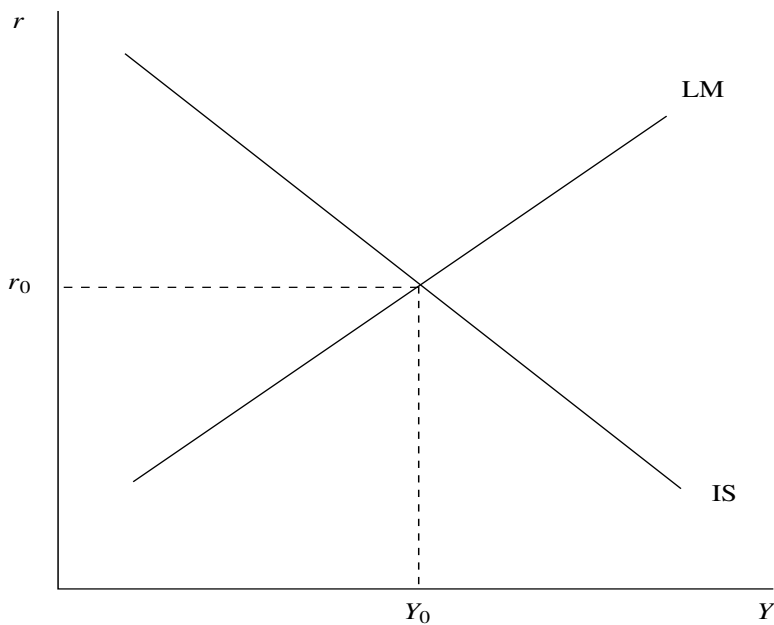


Figure 4: IS–LM: goods-market and money-market equilibrium

Note, however, that in IS–LM equilibrium, real GDP is *not* necessarily at its potential level, Y^* . In the diagram above, it is possible that Y^* lies to the right of the current equilibrium value Y_0 . In other words, IS–LM equilibrium does not imply full employment.