Romer (3rd edition)

Chapter 5
TRADITIONAL KEYNESIAN THEORIES OF FLUCTUATIONS

This chapter and the next develop models of fluctuations based on the assumption that there are barriers to the instantaneous adjustment of nominal prices and wages. As we will see, sluggish nominal adjustment causes changes in the aggregate demand for goods at a given level of prices to affect the amount that firms produce. As a result, it causes purely monetary disturbances (which affect only demand) to change employment and output. In addition, many real shocks, including changes in government purchases, investment demand, and technology, affect aggregate demand at a given price level. As a result, sluggish price adjustment creates a channel other than the intertemporal-substitution and capital-accumulation mechanisms of basic real-business-cycle models through which these shocks affect employment and output.

This chapter takes nominal stickiness as given. It has two main goals. The first is to investigate aggregate demand. We will examine the determinants of aggregate demand and the effects of changes in aggregate demand in both closed and open economies. The second is to consider alternative assumptions about the form of nominal rigidity. We will investigate different assumptions' implications for firms' willingness to change output in response to changes in aggregate demand and for the behavior of real wages, markups, and inflation. Chapter 6 then turns to the questions of why nominal prices and wages might not adjust immediately to disturbances.

Because the models we will consider in this chapter are based on traditional Keynesian models, both their substance and their modeling strategy are at the other extreme from the pure real-business-cycle models of Chapter 4. The models in this chapter often directly specify relationships among aggregate variables. The relationships are often static, and the models' implications for the behavior of some variables (such as the capital stock) are sometimes omitted from the analysis. In addition, rather than specifying stochastic processes for the exogenous variables, the analysis focuses on the effects of one-time changes. And the models are so stylized that any effort to see how well they match overall features of the economy is of little value.

The remainder of the chapter consists of six sections. Sections 5.1 and 5.2 develop the aggregate demand side of the standard Keynesian model. These sections take as given that nominal prices and wages are not completely flexible, and that firms change their output in response to changes in demand. Section 5.1 assumes a closed economy, and Section 5.2 considers the open-economy case.

Sections 5.3 and 5.4 consider aggregate supply. Section 5.3 shows how different combinations of wage rigidity, price rigidity, and non-Walrasian features of the labor and goods markets yield different implications about the effect of shifts in aggregate demand on output, unemployment, the real wage, and the markup. Section 5.4 discusses short-run and long-run output-inflation tradeoffs.

Finally, Sections 5.5 and 5.6 discuss some empirical evidence about the real effects of monetary changes and the cyclical behavior of the real wage.

5.1 Aggregate Demand

Since Keynesian models assume that there is some nominal stickiness, it is easiest to start by assuming that the price level is completely fixed. With this assumption, the determination of output and the interest rate for a given price level is described by two equations, one concerning the demand for goods and the other concerning the money market.

The *IS* Curve

The *IS* curve shows the combinations of output and the interest rate such that planned and actual expenditures on output are equal.[1] Planned real expenditure depends positively on real income, negatively on the real interest rate, positively on government purchases of goods and services, and negatively on taxes:

$$E = E(Y, r, G, T), \quad 0 < E_Y < 1, \; E_r < 0, \; E_G > 0, \; E_T < 0. \tag{5.1}$$

Here E is planned real expenditure, Y real output, r the real interest rate, G real government purchases, and T real taxes. E_Y, E_r, and so on denote the partial derivatives of $E(\bullet)$. G and T are taken as given. The negative effect of the real interest rate on planned expenditure operates through firms' investment decisions and through consumers' purchases, particularly of durable goods. Planned expenditure is assumed to increase less than one-for-one with income; that is, $0 < E_Y < 1$.

[1] The *IS* curve is often described as showing equilibrium in the goods market. But since supply is ignored, this is not an accurate description.

In textbook treatments, E is often expressed in terms of its component parts, and strong assumptions are made about how the determinants of planned expenditure enter. A standard formulation is

$$E = C(Y - T) + I(r) + G, \tag{5.2}$$

where $C(\bullet)$ is consumption and $I(\bullet)$ is investment. The restrictions imposed in this specification may be highly unrealistic. For example, there is considerable evidence that the real interest rate affects consumption, and almost overwhelming evidence that income influences investment. To give another example, there is little basis for assuming that income and taxes have equal and opposite effects on planned real expenditures. Since the general formulation in (5.1) is only slightly more difficult, we will use it in what follows.

If one treats goods that a firm produces and then holds as inventories as purchased by the firm, then all output is purchased by someone. Thus actual expenditure equals the economy's output, Y. In equilibrium, planned and actual expenditures must be equal. If planned expenditure falls short of actual expenditure, for example, firms are accumulating unwanted inventories; they will respond by cutting their production. Thus equilibrium requires

$$E = Y. \tag{5.3}$$

Substituting (5.3) into (5.1) yields

$$Y = E(Y, r, G, T). \tag{5.4}$$

Figure 5.1, the *Keynesian cross,* depicts equations (5.1) and (5.3) in (Y, E) space for a given level of the interest rate. Equation (5.3) is just the 45-degree line. Since planned expenditure increases less than one-for-one with Y, the set of points satisfying (5.1) is less steep than the 45-degree line. The point where the planned expenditure curve crosses the 45-degree line (Point A) shows the unique level of income where actual and planned expenditures are equal for the given interest rate.[2]

An increase in the interest rate shifts the planned expenditure line down (since $E(\bullet)$ is decreasing in r), and thus reduces the level of income at which actual and planned expenditures are equal. In terms of the diagram, an increase in the interest rate from r to r' shifts the intersection of the two lines from Point A to Point B. Thus in (Y, r) space, the IS curve slopes down. This is shown in Figure 5.2.

Differentiating both sides of (5.4) with respect to r yields

$$\left.\frac{dY}{dr}\right|_{IS} = E_Y\left(\left.\frac{dY}{dr}\right|_{IS}\right) + E_r, \tag{5.5}$$

[2] The Keynesian cross is sometimes described as a theory of income determination. But this is correct only if the interest rate can be treated as fixed, which is usually inappropriate.

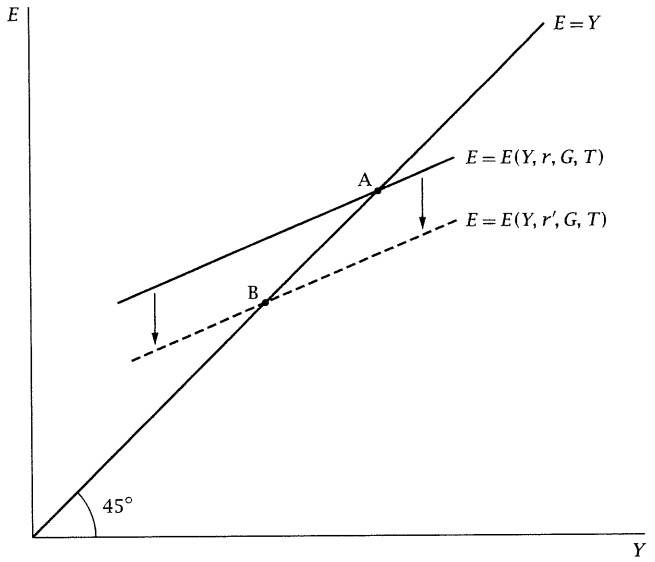


FIGURE 5.1 The Keynesian cross

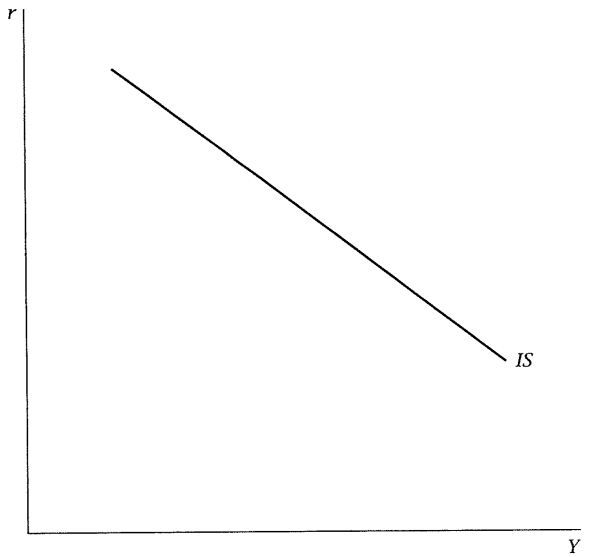


FIGURE 5.2 The *IS* curve

or

$$\left.\frac{dY}{dr}\right|_{IS} = \frac{E_r}{1 - E_Y}, \tag{5.6}$$

where $\left.\frac{dY}{dr}\right|_{IS}$ denotes dY/dr along the *IS* curve. Since this is an expression for dY/dr (rather than dr/dY), it implies that the *IS* curve is flatter when either E_r or E_Y is larger. Intuitively, the larger the effect of the interest rate on planned expenditure, the larger the downward shift of the planned expenditure line, and thus the larger the fall in output. Similarly, the steeper the planned expenditure line, the more output must fall in response to a given downward shift of the planned expenditure line to reach a point where planned and actual expenditures are again in balance, and thus the larger the fall in output. This last effect is the famous *multiplier:* because E depends on Y, the fall in Y needed to restore the equality of E and Y is larger than the amount that E falls at a given Y.

The Money Market

To determine r and Y, we need a second equation. This is provided by the condition for equilibrium in the money market. It is simplest to think of money as high-powered money—currency and reserves—issued by the government. Since high-powered money pays no nominal interest, the opportunity cost of holding it is the nominal interest rate. The demand for real money balances is therefore a decreasing function of the nominal interest rate. In addition, since the volume of transactions is greater when output is higher, the demand for real balances is increasing in output. Thus the condition for the supply and demand of real balances to be equal is

$$\frac{M}{P} = L(r + \pi^e, Y), \qquad L_{r+\pi^e} < 0, \qquad L_Y > 0, \tag{5.7}$$

where M is the quantity of money and P is the price level, and where the nominal interest rate is expressed as the sum of the real interest rate, r, and expected inflation, π^e.

The traditional approach to analyzing (5.7) is to take M as exogenous. In addition, since we are assuming completely fixed prices for the moment, P is fixed and π^e is zero. Thus with these assumptions, the left-hand side of (5.7) is $M/\bar{P}$ and the right-hand side is $L(r, Y)$. Since $L(r, Y)$ is decreasing in r and increasing in Y, the set of combinations of r and Y that satisfy $M/\bar{P} = L(r, Y)$ is upward-sloping in (Y, r) space. This locus is known as the *LM* curve. Under the assumption that the money supply is exogenous, the *IS* and *LM* curves determine output and the real interest rate.

Taylor (1995) proposes a slightly different approach. Modern central banks do not target the money supply. Instead, they adjust it to achieve a target for the interest rate, and they adjust their interest-rate target in response to movements in output and inflation. Thus rather than assuming that M is exogenous, we will assume that the central bank follows an interest-rate rule. Writing the rule as one for the real interest rate, we can express it as

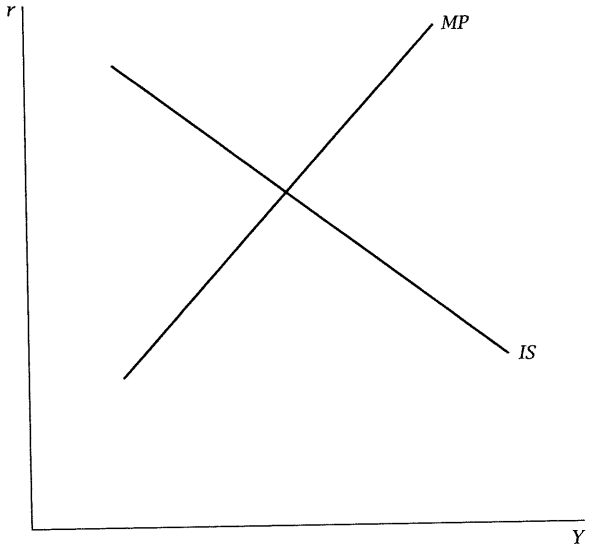


FIGURE 5.3 The *IS-MP* diagram

$$r = r(Y, \pi), \qquad r_Y > 0, \qquad r_\pi > 0. \tag{5.8}$$

This assumption leads directly to an upward-sloping locus in (Y, r) space. This locus is known as the *MP* curve. It is shown together with the *IS* curve in Figure 5.3.[3]

When the central bank follows an interest-rate rule, it adjusts the money supply so that the interest rate follows the rule. That is, M is an endogenous variable given by

$$M = PL(r(Y, \pi) + \pi^e, Y). \tag{5.9}$$

For most purposes, however, we can simply ignore the money supply and focus on the *IS* equation and the interest-rate rule.

Because it is both simpler and more realistic, we will employ the *MP* approach in what follows. For most purposes, however, the *LM* approach has similar implications.

[3] Sections 10.6 and 10.7 provide a more detailed discussion of interest-rate rules.

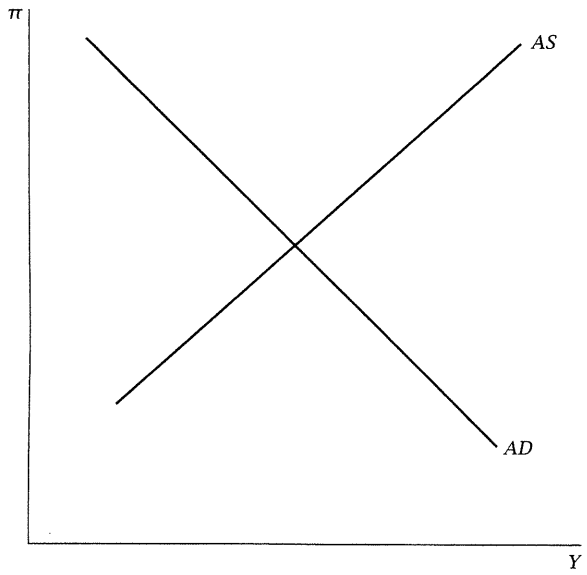


FIGURE 5.4 The *AS-AD* diagram

The *AS-AD* Diagram

When prices are not completely fixed, the determination of output and inflation can be described by two curves in output-inflation space, an upward-sloping aggregate supply (*AS*) curve and a downward-sloping aggregate demand (*AD*) curve. They are shown in Figure 5.4. The *AS* curve is the subject of Sections 5.3 and 5.4 and of most of Chapter 6. For now, however, we just assume some positive relationship between output and inflation:

$$\pi = \pi(Y), \qquad \pi'(\bullet) \geq 0. \tag{5.10}$$

Thus, we are relaxing our assumption that prices are completely fixed in favor of the assumption that inflation has some response to output.

The *AD* curve comes from the *IS* and *MP* curves. To see this, consider a rise in inflation. Since π does not enter the planned expenditure function, $E(\bullet)$, the *IS* curve is unaffected. But since the monetary-policy rule, $r = r(Y, \pi)$, is increasing in π, the rise in inflation increases the real interest rate the central bank sets at a given level of output. That is, the *MP* curve shifts up. As a result, as Figure 5.5 shows, r rises and Y falls. Thus the level of output at the intersection of the *IS* and *MP* curves is a decreasing

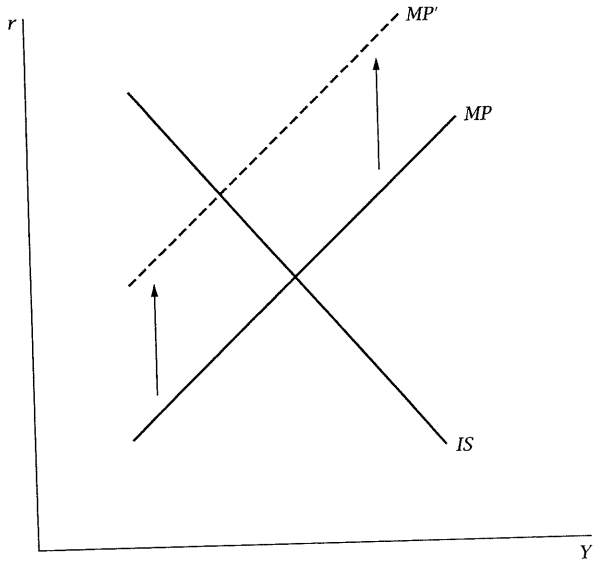


FIGURE 5.5 The effects of an increase in inflation

function of the inflation rate. This is what is shown by the aggregate demand curve.[4]

To find how much Y changes in response to a change in π, differentiate (5.4) and (5.8) with respect to π. This yields two equations in two unknowns:

$$\left.\frac{dY}{d\pi}\right|_{AD} = E_Y \left.\frac{dY}{d\pi}\right|_{AD} + E_r \left.\frac{dr}{d\pi}\right|_{AD}, \tag{5.11}$$

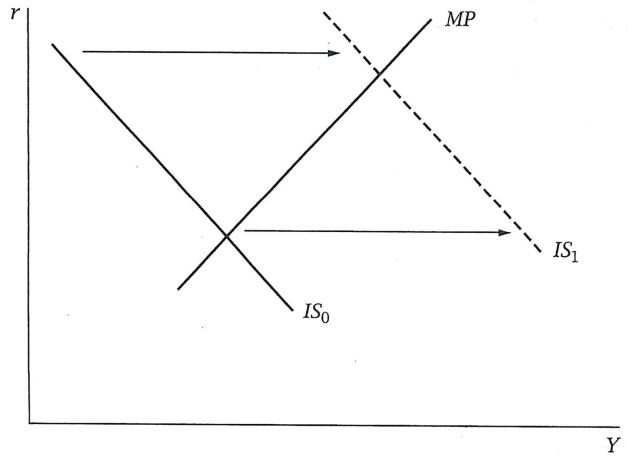
$$\left.\frac{dr}{d\pi}\right|_{AD} = r_\pi + r_Y \left.\frac{dY}{d\pi}\right|_{AD}. \tag{5.12}$$

These can be solved to obtain

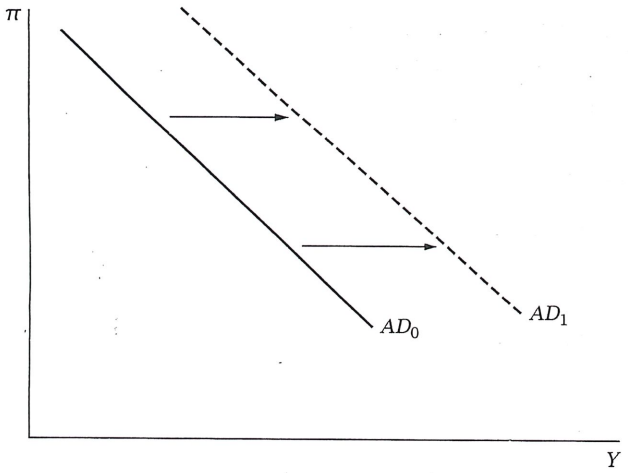
$$\left.\frac{dY}{d\pi}\right|_{AD} = \frac{r_\pi}{[(1 - E_Y)/E_r] - r_Y}. \tag{5.13}$$

This expression is unambiguously negative, and it shows the determinants of the slope of the aggregate demand curve.

[4] When prices are not completely flexible, P and π^e, as well as π, can vary. However, these two variables only enter the model in equation (5.9), which describes how the central bank must adjust the money supply to follow its interest-rate rule. Thus for the most part they can be neglected. See Problem 5.2.



(a)



(b)

FIGURE 5.6 The effects of an increase in government purchases

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IS and *MP* curves provide a simple model of aggregate demand that can sed to analyze many issues. Suppose, for example, that government hases rise. The increase in G raises planned expenditure for a given

level of output and the interest rate. The planned expenditure line in Figure 5.1 therefore shifts up, and so the level of Y such that actual and planned expenditures are equal is higher for a given level of the interest rate. Thus the *IS* curve shifts to the right; this is shown in Panel (a) of Figure 5.6. The shift in the *IS* curve raises Y (and r) for a given inflation rate, and thus moves the *AD* curve outward; this is shown in Panel (b) of the figure.[5]

The impact of this change in aggregate demand on output and inflation depends on the aggregate supply curve. If it is vertical, only inflation increases. If it is horizontal, only output increases. And if it is upward-sloping but not vertical, both output and inflation increase.

Thus, incomplete adjustment of nominal prices introduces a new channel through which shocks affect output. For some reason, which we have not yet specified, nominal prices do not adjust fully in the short run. As a result, any change in the demand for goods at a given price level affects output. In contrast, the intertemporal-substitution and wealth effects that drive employment fluctuations in real-business-cycle models would correspond to effects of government purchases on the aggregate supply curve—that is, they would affect not the quantity of output that households and firms want to buy at a given price level, but the quantity that firms want to produce at a given price level.

5.2 The Open Economy

In most practical applications, the exchange rate and international trade are important to short-run fluctuations. This section therefore extends the *IS-MP* model to the case of an open economy.

The Real Exchange Rate and Planned Expenditure

It is simplest to think of the rest of the world as consisting of a single country. Let e denote the nominal exchange rate—specifically, the price of a unit of foreign currency in terms of domestic currency. With this definition, a rise in the exchange rate means that foreign currency has become more expensive, and therefore corresponds to a weakening, or depreciation, of the domestic currency. Similarly, a fall in e corresponds to an appreciation of the domestic currency. Let P^* denote the price level abroad (that is, the price of foreign goods in units of foreign currency). These definitions imply that the real exchange rate—the price of foreign goods in units of domestic goods, denoted ε—is eP^*/P.

[5] The *IS-MP* diagram is drawn for a given value of π. Thus the amount that output increases in the *IS-MP* diagram is the same as the amount that the aggregate demand curve shifts to the right at the value of π assumed in the *IS-MP* diagram.