Economics 285

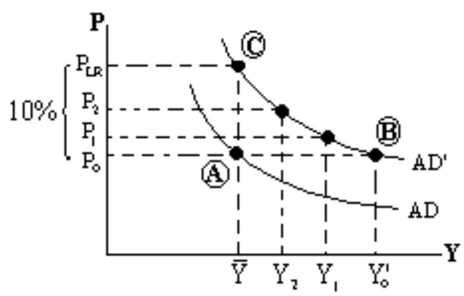
Chris Georges A Basic Model of Dynamic Aggregate Supply

Mankiw develops a model of dynamic AS (sometimes called a Phillips Curve model) in Ch. 15. We will start with a slightly simpler version that is consistent with our assumption of price stickiness in Chs. 10–12.

Here, following our approach in Chs. 10–12, we will assume that the general price level does not respond to changes in AD in the short run (i.e., within a single period in our model), and will flesh out how this price level changes over time as well as how it responds to supply shocks.

A Preliminary Model:

The simplest assumption would be that the price level rises if output is above its *natural* or *full employment* rate (i.e., if $Y > \bar{Y}$) and falls if output is below this rate (i.e., if $Y < \bar{Y}$). This is consistent with the analysis in Ch. 10.4 and 12.2 in which, starting at $\bar{Y}$, an increase in AD (e.g., due to an increase in the money supply by 10%) would cause output to increase in the short run, but would then cause price to rise in the long run, driving spending and thus output back to $\bar{Y}$ in the long run. (See Figures 10-12, 10-13, and 12-7 in the text for additional illustrations.)



This simple dynamic aggregate supply story could be represented by the following equation:

$$\pi_t = \phi \cdot (Y_{t-1} - \bar{Y})$$

where ϕ is a small positive number that reflects the responsiveness of inflation to the output gap. This equation says that if output is above it natural rate in a given period, then the inflation rate will be positive in the following period. For example, suppose that $\phi = 0.01$. Then if output is 9200 this period and the natural rate is 9000, the price level will rise by 2% next period. The price level will continue to rise as long as output is above $\bar{Y}$. Note then that given this dynamic AS model, the economy is self correcting (Y tends to return to $\bar{Y}$ over time). Note also that (in this simple version) once output has returned to $\bar{Y}$, there will be no more inflation.

This is a good start, but there are at least two problems with this formulation. First, most economies like ours often have persistent inflation even at full employment $\bar{Y}$. Second, there is no role in the equation above for supply shocks. Consequently we will want to use the following richer model.

The Basic Dynamic AS Model:

Dynamic AS $$\pi_t = \mathrm{E}_{t-1}\pi_t + \phi \cdot (\mathrm{E}_{t-1}Y_t - \bar{Y}) + v_t$$

where E_{t-1} stands for *expectations* formed using information available at the end of period t-1 (i.e., formed prior to oberving outcomes in the current period), and v is a direct price shock which is zero on average. This equation says that the inflation rate this period depends on three factors: expected inflation this period, the expected output gap this period, and price shocks this period.

Here is an underlying story for this model: Suppose that firms set their prices at the beginning of each period (t) and keep these prices fixed during the period as long as their costs of production do not change.

When setting price at the beginning of the period, each firm first considers how much it thinks that its competitors and suppliers will raise their prices. Other things equal, assume that the firm will want to match this expected rate of inflation $E_{t-1}\pi_t$ (e.g., it won't gain or loose market share if it matches its competitors' price increases). However, the firm also considers whether it expects the economy to be in a recession or boom this period. If it expects a boom ($E_{t-1}Y_t > \bar{Y}$), it will raise its prices more than it expects others to, and if it expects a recession ($E_{t-1}Y_t < \bar{Y}$), it will try to undercut others' price increases. Finally, if there is a shock to the firm's costs (e.g., $v > 0$), then the firm will pass on this change in costs directly to prices, even if the shock happens after the firm has set its price for the period. I.e., we are assuming that the firm will not change price within this period in response to a surprise change in demand, but will change price immediately in response to a surprise change in costs.

The Basic Dynamic AS Model with Adaptive Expectations:

It still remains to specify how these firms form their expectations. A very simple modeling assumption would be that firms believe that the future will be similar to the past. We can call this type of expectations *adaptive expectations*. A very simple form of adaptive expectations would be the expectation that this period will look just like last period. I.e.:

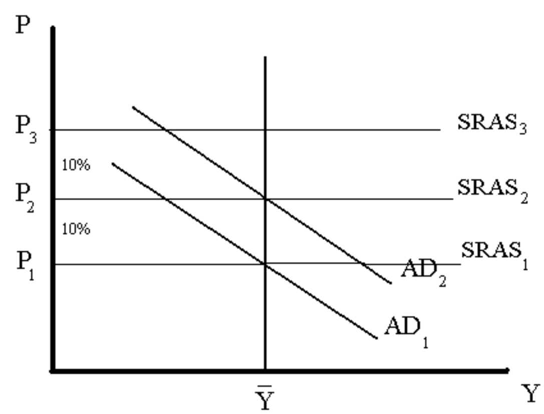
$$E_{t-1}Y_t = Y_{t-1} \qquad \text{and} \qquad E_{t-1}\pi_t = \pi_{t-1}$$

Then the Dynamic AS in conjunction with these simple Adaptive Expectations would yield

$$\pi_t = \pi_{t-1} + \phi \cdot (Y_{t-1} - \bar{Y}) + v_t$$

Notice that AD and the Phillips Curve together with adaptive expectations imply that prices adjust over time in the direction required to bring Y back to $\bar{Y}$ in the Long Run. If, for example, output is below its natural rate, the inflation rate will fall over time. When the inflation rate becomes negative, output will rise toward $\bar{Y}$ along the AD curve.

However, notice also that adaptive expectations make inflation very persistent. Suppose that in a particular period (call it period 2) inflation was 10% and output was $\bar{Y}$. Assume that there are no supply shocks. Then in period 3, expected inflation will be 10% and there will be no expected output gap, so actual inflation will be 10%. Each firm expects all other firms to raise price, and so raises its own price. Note then that, in the absence of other demand shocks, if the Fed doesn't increase the money supply by 10% in period 3, the rising price level will cause spending to fall below $\bar{Y}$ causing a recession in that period. This puts pressure on the Fed to keep raising the money supply. However, while doing so keeps us out of a recession, it also keeps inflation at 10% in the future.



Note that in the diagram, what happens to output in period 3 depends on what happens to AD in period 3. In the absence of other shocks, if the Fed were to freeze the money supply, then AD_3 would be the same as AD_2, and the economy would go into a recession. If the Fed were to increase the money supply by 10%, then AD would rise fast enough to offset the increase in price and keep output at $\bar{Y}$.

So putting together the basic dynamic AS model with our AD model derived from ISLM, we have a fairly complete but simple model of the short and long run dynamics of a modern macro economy.

Preview: The Ch. 15 Extended Dynamic Model of AS and AD

In Ch. 15, Mankiw extends the basic dynamic model (of AS and AD) described above in two ways.

First, he makes prices only *partly* sticky in the SR. The assumption here is that some firms have flexible prices and some have fixed prices in the short run. This makes the SRAS curve upward sloping and implies that prices and inflation will adjust (at least partly) in short run to shifts of the AD curve.

Second the Ch. 15 model builds the *monetary policy* reactions of the central bank into the AD model. Essentially, we still have ISLM, but we add to this the assumption that the central bank follows a rule for setting interest rates. This allows us to replace LM with this monetary policy rule for most of our analysis.[1] The type of monetary policy rule Mankiw uses in Ch. 15 is often called a "Taylor Rule."

One benefit of moving to the somewhat more complicated model of Ch. 15 is that it allows us to represent the equilibrium state of *inflation* (rather than the price level) and output on a dynamic AS-AD diagram (DAS and DAD) with inflation and output on the axes.

[1] We can go back to LM if we want to see what the central bank needs to do to the money supply to achieve its interest rate goal. Otherwise we no longer need the LM model since we are assuming that the central bank will do whatever it takes to meet its interest rate goal (i.e., to follow its interest rate rule).