Economics 435
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Aggregate Demand – Aggregate Supply (ADAS1)

1. The Basic Model with Expected Inflation Set to Zero

Consider the Phillips curve relationship:

$$\frac{P_t - P_{t-1}}{P_{t-1}} \equiv \pi_t = \pi_t^e + f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right)$$

In order to analyze the model more closely, let's make a simplifying assumption, namely that expected inflation is zero. This leads to:

$$\frac{P_t}{P_{t-1}} - 1 \equiv \pi_t = f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right) \quad \text{Rearranging:} \quad \frac{P_t}{P_{t-1}} = 1 + f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right)$$

Multiplying both sides by the previous price level:

$$P_t = P_{t-1} + P_{t-1} \times f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right)$$

This equation indicates that the current price level is equal to last period's price level if output last period equaled potential GDP. It will be higher than last period's if last period's output exceeded potential.

Now consider what would happen starting from a position of initial rest. Assume to begin with in periods 0 and 1 $Y_t=Y^*$, and $A_t=A_1$, $M_t=M_1$. Then suppose in period 2, autonomous spending increases to A_2 (perhaps because of an increase in government spending). Then output rises in period 2 to Y_2, but the price level stays constant. Only in period 3 does the price level rise (since $Y_2 > Y^*$).

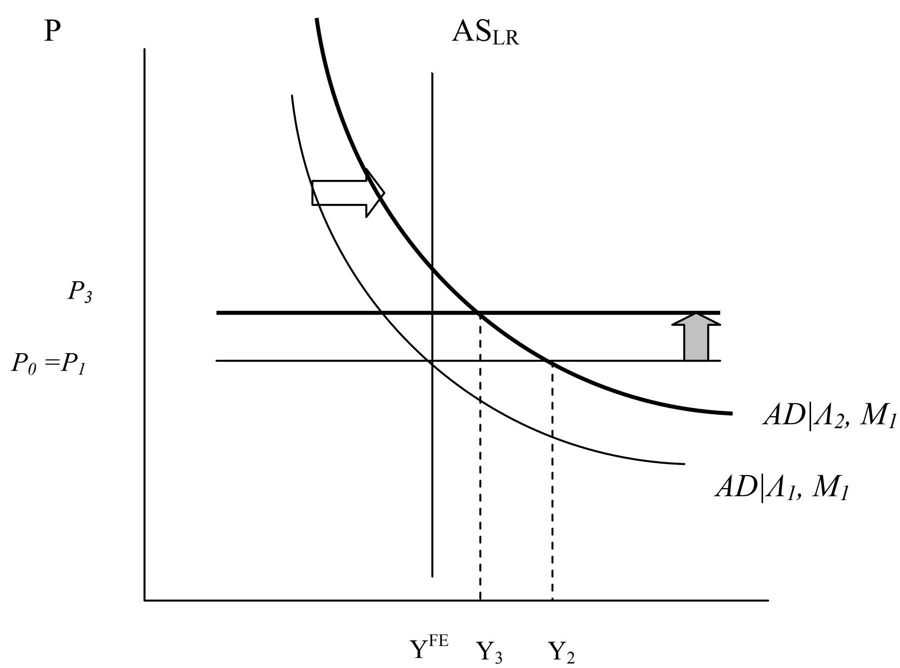

Figure 1: Note $A_2 > A_1$

How does this AD-AS diagram relate to the IS-LM diagram we used before? One way to think about the diagram is that movements along the predetermined price line were consistent with the solution of the IS-LM diagram. To see what happens in the process of adjustment to lower income as the price level rises, consider this pairing of diagrams.

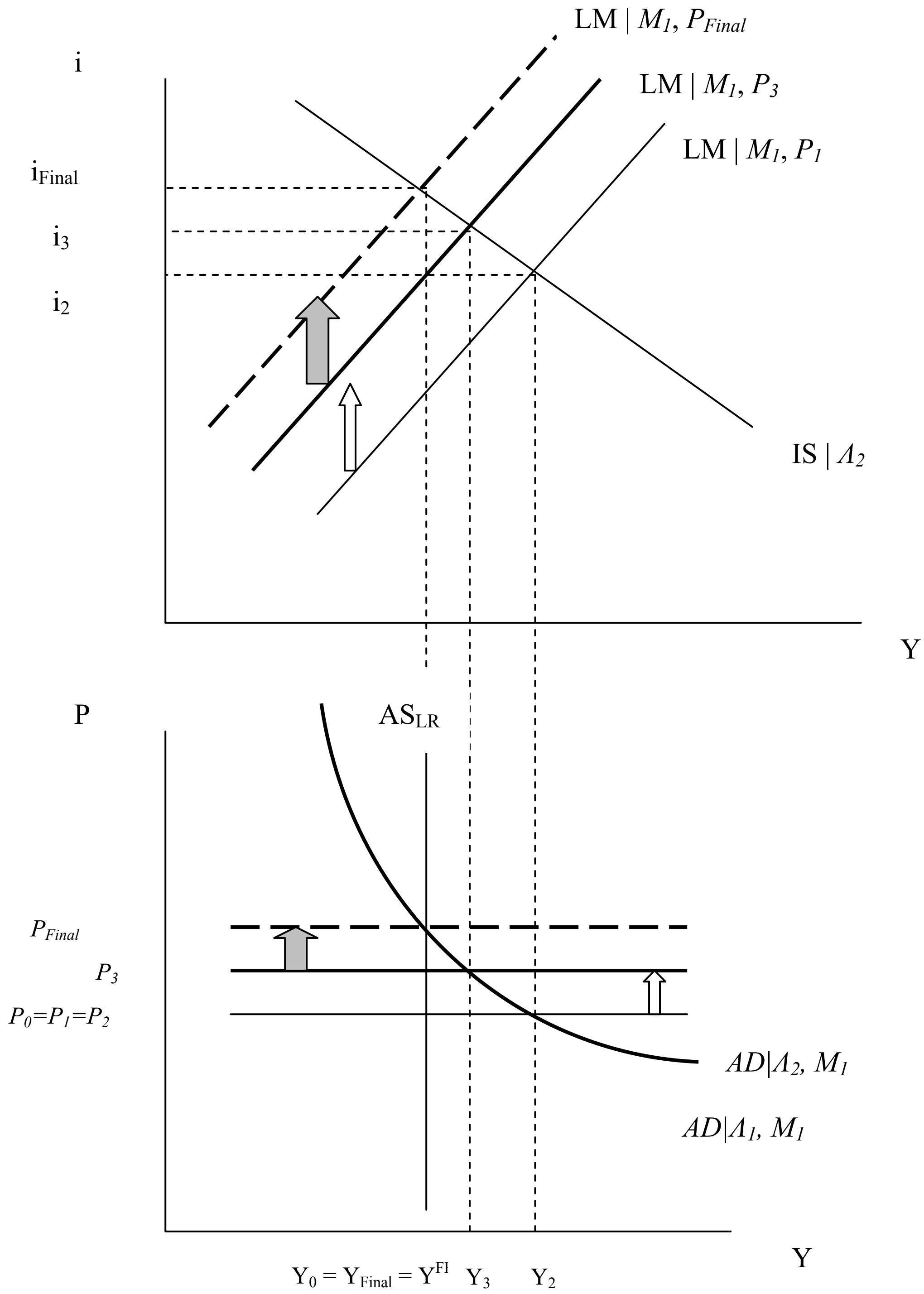

Figure 2: Note $P_3 > P_2$

Notice that over the longer term, the price level keeps on rising (as long as output exceeds potential GDP), the real money stock keeps on falling, shifting back the LM curve, until finally output equals potential, the price level equals P_{Final} , the interest rate equals i_{Final} .

AD-AS with, Expectations, Supply Shocks (ADAS2)

1. The Expectations Augmented Phillips Curve

Consider the Phillips curve:

$$\frac{P_t - P_{t-1}}{P_{t-1}} \equiv \pi_t = \pi_{t-1} + f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right)$$

Where it is assumed $\pi_t^e = \pi_{t-1}$; this is often called the expectations augmented Phillips curve with adaptive inflationary expectations (i.e., expected inflation is just equal to last period's ex post inflation rate). The result of this revision is to make the price level overshoot its long run level, and output to undershoot. Eventually, output and the price level return to where they would have gone if $\pi_t^e = 0$ (as in the previous handout). Let's reconsider the graphs we used in the previous handout, this expression.

The key here is to multiply out to see how the price level evolves, after taking into account expected inflation (here equal to lagged inflation):

$$P_t = P_{t-1} + P_{t-1} \times \pi_{t-1} + P_{t-1} \times f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right)$$

Now consider what would happen starting from a position of initial rest, *and initial inflation equal zero*. Assume to begin with in periods 0 and 1 $Y_t=Y^*$, and $A_t=A_1$, $M_t=M_1$. Then suppose in period 2, autonomous spending increases to A_2 (perhaps because of an increase in government spending). Then output rises in period 2 to Y_2, but the price level stays constant.

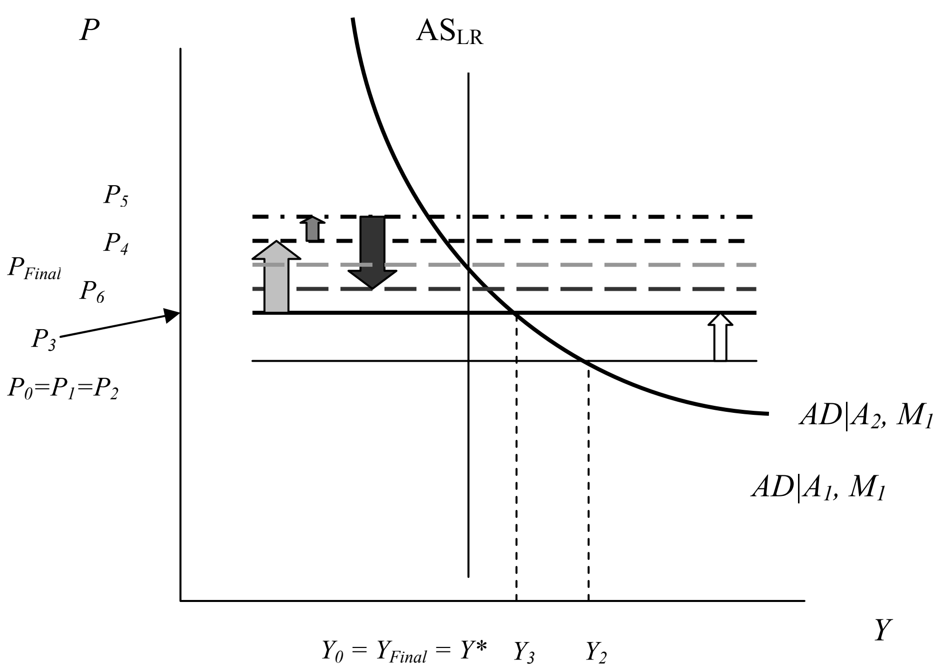

Figure 1: Expansionary fiscal policy in Period 2, with no initial inflation, and expectations augmented Phillips curve

Only in period 3 does the price level rise (since $Y_2 > Y^*$).

$$P_t = P_{t-1} + P_{t-1} \times \pi_{t-1} + P_{t-1} \times f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right)$$

$$P_3 = P_2 + P_2 \times \pi_2 + P_2 \times f\left(\frac{Y_2 - Y^*}{Y^*}\right)$$

But since inflation in period 2 was zero, then expected inflation in period 3 is also zero, and the rise to P_3 is the same here as in the previous handout.

In period 4, prices rise again, but notice that since $P_3 > P_2$, $\pi_3 > 0$:

$$P_4 = P_3 + P_3 \times \pi_3 + P_3 \times f\left(\frac{Y_3 - Y^*}{Y^*}\right)$$

So prices would rise more than in the case where inflationary expectations were already zero. Notice that since lagged inflation is incorporated into the price level, then the price level will overshoot its long run level (as it does at P_4) . Notice that going to period 5, the previous period's output gap is negative, so that portion will exert negative pressure on the price level. The way I've drawn this figure, lagged inflation outweighs lagged (negative) output gap, so that the price level continues to rise. Only in period 6 does the (very large) negative output gap overwhelm the upward momentum from lagged inflation, so that prices fall to P_6.

The exact trajectory depends on the magnitudes of the parameter $f(.)$ (as well as the slope of the aggregate demand curve), but as long as expected inflation equals lagged inflation, then the price level will overshoot the long run value, before eventually settling at P_{Final} (which is the same as it would be in the case where inflationary expectations did not matter). Technically, both P and Y will oscillate with ever shrinking deviations to their final values of P_{Final} and Y^*.

2. Incorporating Supply Shocks

In order to incorporate a role for supply shocks, consider the revision to the Phllips curve:

$$\pi_t = \pi_{t-1} + f\left(\frac{Y_{t-1} - Y^*}{Y^*}\right) + Z_t$$

This is the Phillips curve with a supply shock effect, ***Z***.

How does this variable behave? Consider what would if there were a one period increase in the price *level* of inputs (like oil). In that case **Z** > 0 for one period, and 0 thereafter.

Let's now examine the impact of an oil price shock on the model. Starting from a position of initial rest, with zero inflation in periods 0 and 1 and $Y_t = Y^*$. Suppose in period 2, $\boldsymbol{Z_2} > 0$. Then output falls in period 2 to Y_2, as the price level rises. In period 3, since inflation in period 2 was greater than zero, expected period 3 inflation is also greater than zero. ***Z*** is zero for this period, so with the lagged output gap negative, the price level falls. Then output rises in period 3 relative to that in period 2.

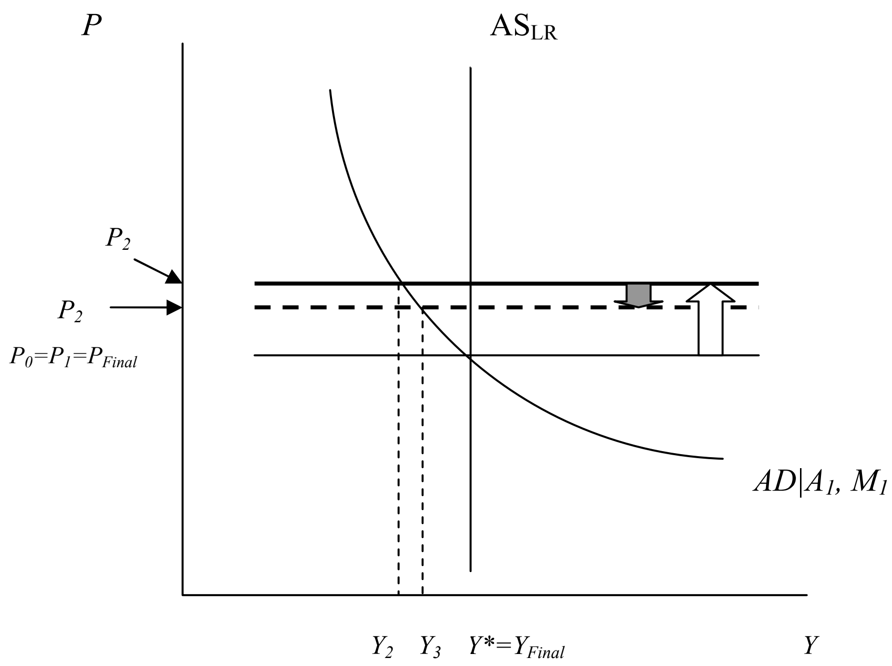

Figure 2: Oil Shock in Period 2, expectations augmented Phillips curve, no offsetting policy

Eventually, output will return to potential, and the price level to the initial price level. However, there will be overshooting on the way to steady state equilibrium.
An alternative scenario involves the government responding with a policy to try to maintain output at potential. Suppose the same shock occurs, but the monetary authorities increase the money supply in an attempt to maintain output. Then the money supply rises from M1 to M2, and the AD curve shifts out.

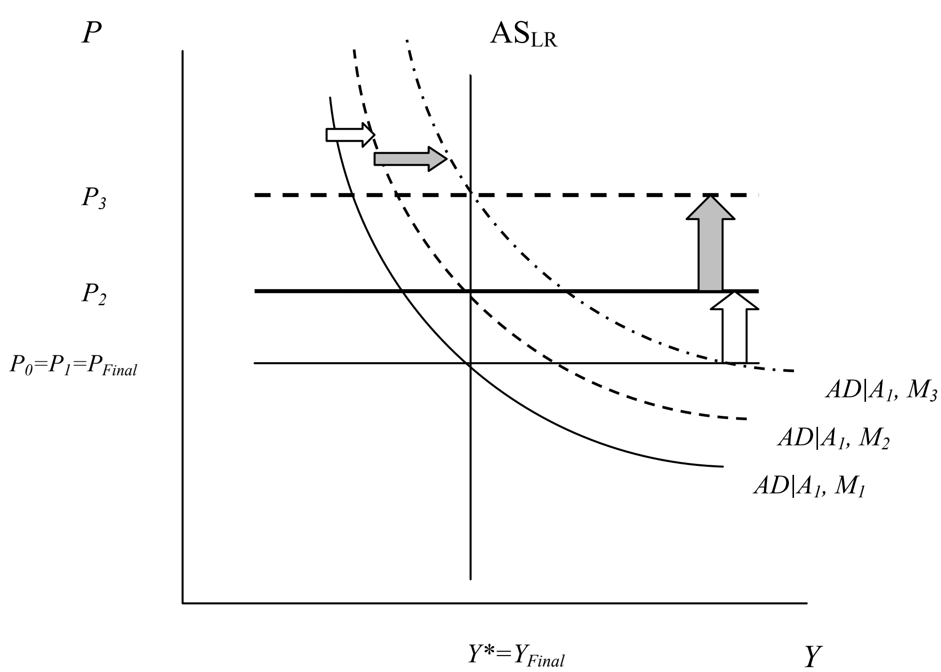

Figure 3: Oil Shock in Period 2, expectations augmented Phillips curve, expansionary monetary policy in Period 2.

Note that when period 3 occurs, inflation will be equal to period 2's inflation; hence the price line will rise again (despite the fact that Z=0 in period 3). In order to keep output at potential, the money supply will have to be increased again.

There is a situation where the effect of an oil shock is more pernicious: if the supply shock (higher oil prices) causes some portion of the capital stock to depreciate. Since $Y^* = \Phi F(K, N)$, Y^* declines, the end-point for the economy is at a permanently lower output level and higher price level.

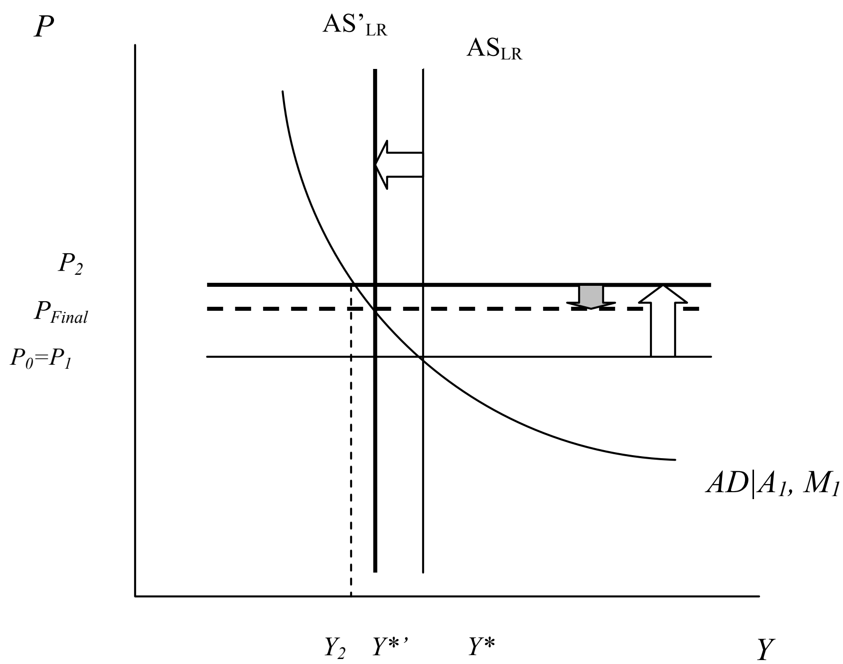

Figure 4: Oil Shock in Period 2 which permanently reduced potential GDP, expectations augmented Phillips curve, no offsetting policy

I've skipped the steps that show overshooting due to lagged inflation feeding into current inflation.