

### Aggregate Demand – Aggregate Supply

In this set of notes, we examine the behavior of the economy over time when the central bank targets the money supply, rather than the interest rate (as in Chapter 6; hence we deviate from this edition of the textbook). We define a relationship between aggregate demand and the price level – i.e., for constant nominal money stock, the real money stock shrinks with higher price levels inducing lower investment and hence aggregate demand. Aggregate supply rises with the price level because at higher levels of output, unemployment is lower, and hence wage levels are higher. With markup pricing, that means also higher price levels. The actual level of economic output depends on both supply and demand. Over time, the price level adjusts as expected prices adjust to match what actual prices are. Over the longer term (medium run), monetary and fiscal policies have no effect.

#### 1. Basics (assuming CB targets $M$ , not $i$ )

For **aggregate demand**: Consider the solution to the IS-LM model.

$$(1) \quad Y = \hat{\gamma} \left[ \Lambda_0 + \frac{b_2}{h} \left( \frac{M_0}{P} \right) - \frac{b_2 \mu_0}{h} \right]$$

Where the price level  $P$  is now *allowed to vary*. This means that there are different levels of aggregate demand for different price levels (Figure 1).

Notice that increases in government spending (increases in  $\Lambda$ ) will shift out the AD curve, while decreases in  $M$  will shift in the AD curve (Figure 2). Notice, this treatment differs from the textbook (Chapters 6, 9) in that we assume the Central Bank targets the money stock ( $M$ ) or equivalently the money base (MB, or H in the textbook).

For **aggregate supply**, start with a wage setting equation, where wages are set as a function of expected price level, the unemployment rate, and other exogenous factors, such as unemployment benefits:

$$(2) \quad W = P^e F(u, z)$$

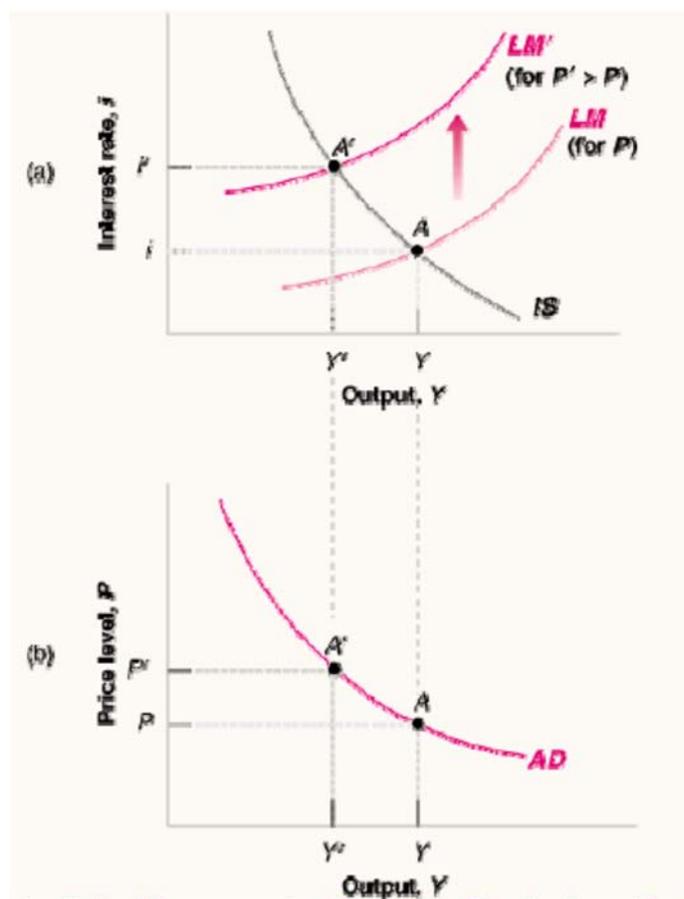


Figure 1: Derivation of AD

The price of output is set as a markup over cost of production – for simplicity assumed to equal the wage rate.

$$(3) \quad P = (1 + \mu)W$$

Substituting (3) into (2) yields:

$$(4) \quad P = P^e (1 + \mu)F(u, z)$$

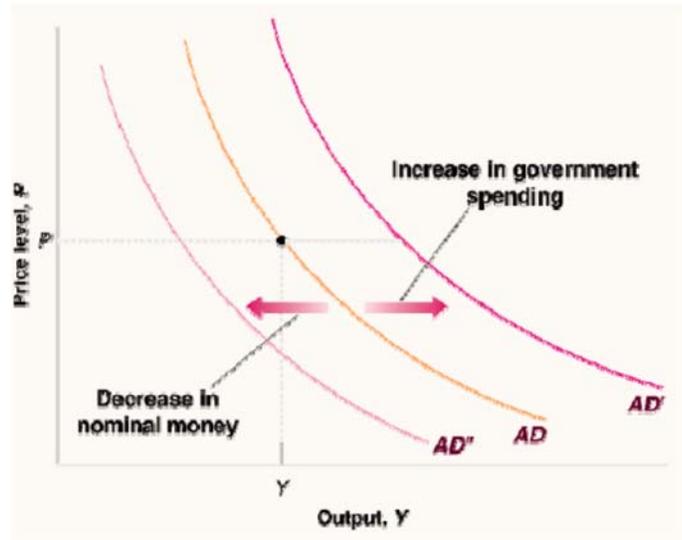
In order to express the price level as a function of output (Y), re-express (4):

$$(5) \quad P = P^e (1 + \mu)F\left(\left[1 - \frac{Y}{L}\right], z\right)$$

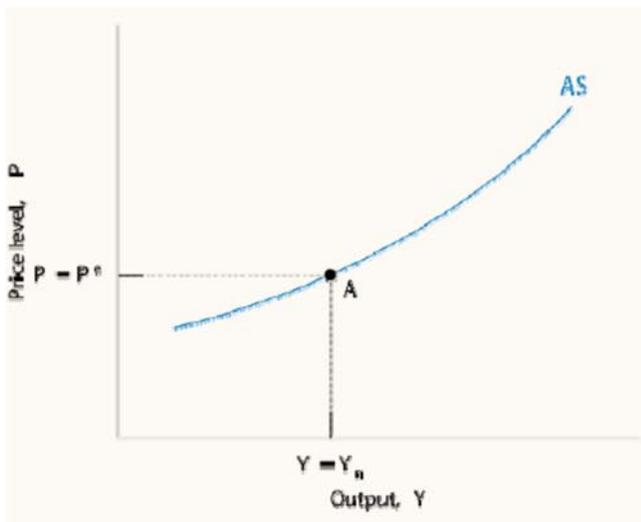
Where we use the definition of unemployment.

$$u \equiv \frac{U}{L} \equiv \frac{L - N}{L} \equiv 1 - \frac{N}{L} = 1 - \frac{Y}{L} \quad (\text{if } Y=N)$$

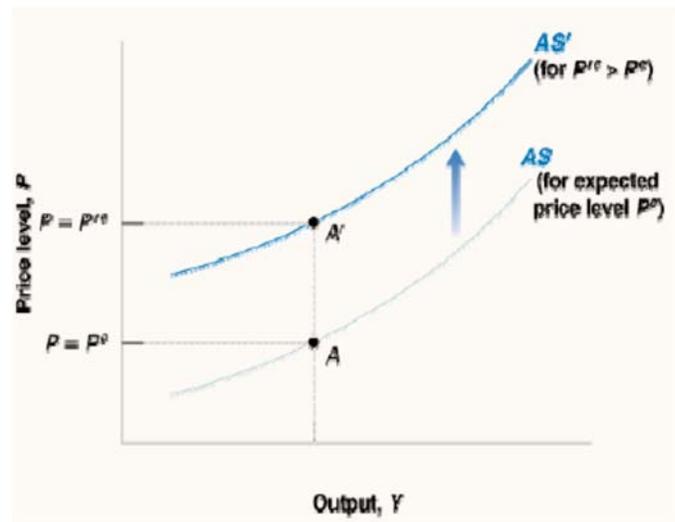
The last item after the equal sign uses the assumption that output is a direct function of employment. Equation (5) is depicted as follows.



**Figure 2:** Shifts in AD



**Figure 3:** Derivation of AS



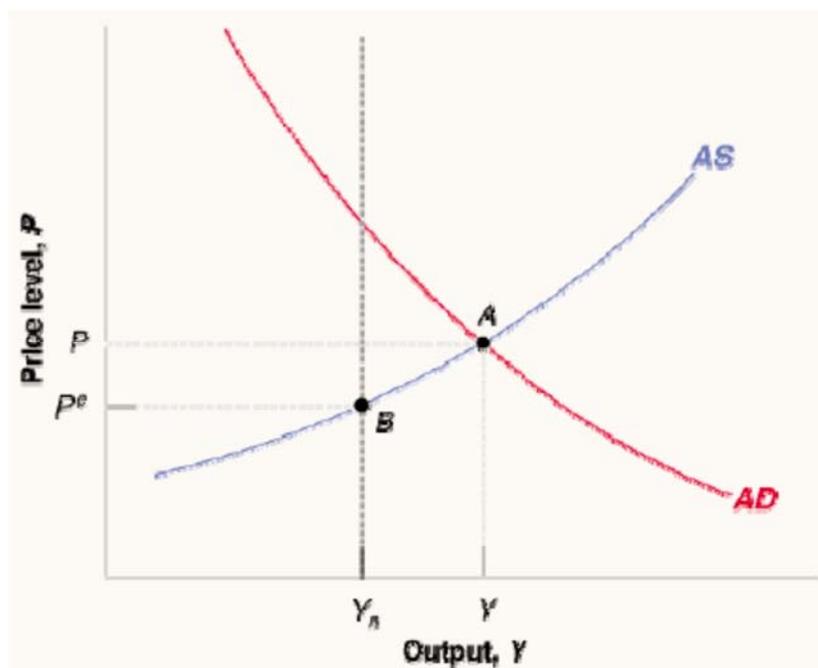
**Figure 4:** Shifts in AS

The AS curve is upward sloping because as wages rise as unemployment declines (for a given expected price level). Should the expected price level rise, then the AS curve shifts up.

## 2. Equilibrium, Short and Medium

Putting together AD and AS, one obtains the short run equilibrium denoted in Figure 5. In this case, both supply and demand side factors interact to determine output and the price level. Once again, note that this short run equilibrium is for a given expected price level.

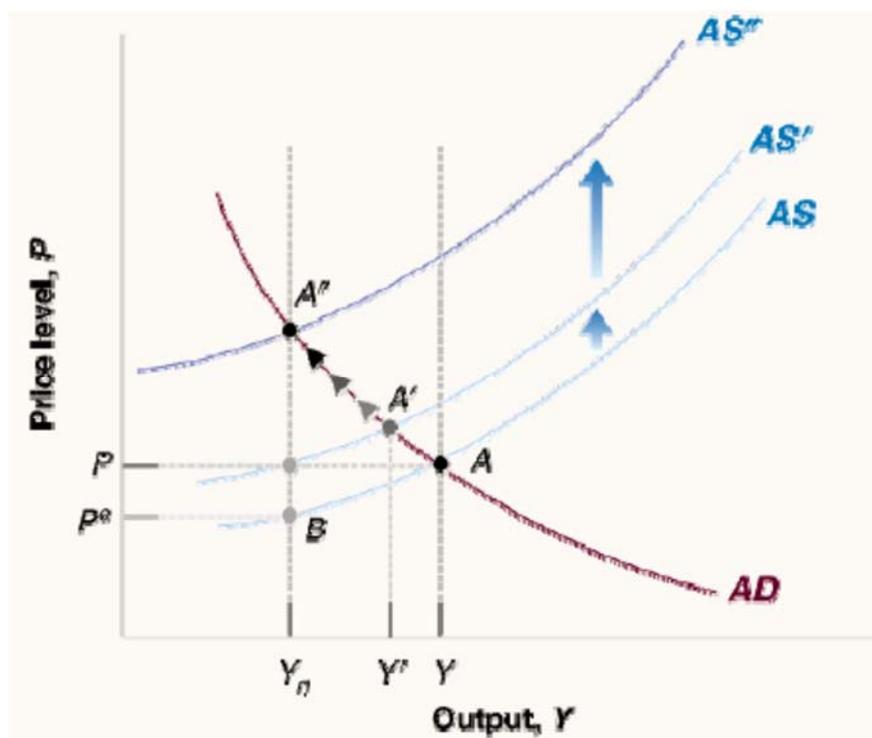
In order to make the model useful for examining the effects over the medium run, one needs to explain how the price level is determined. For simplicity, we will typically use adaptive expectations,  $P^e = P_{-1}$ , that is that the expected price level equals last period's price level.



**Figure 5:** Short run AD-AS equilibrium, natural output

As we move from the period depicted in Figure 5 to the next period, the expected price level rises (Figure 6); the AS curve shifts up to  $AS'$  (the AS curve intersects the  $Y_n$  line at  $P^e$  since by definition output equals the natural rate when the expected price level equals the actual).

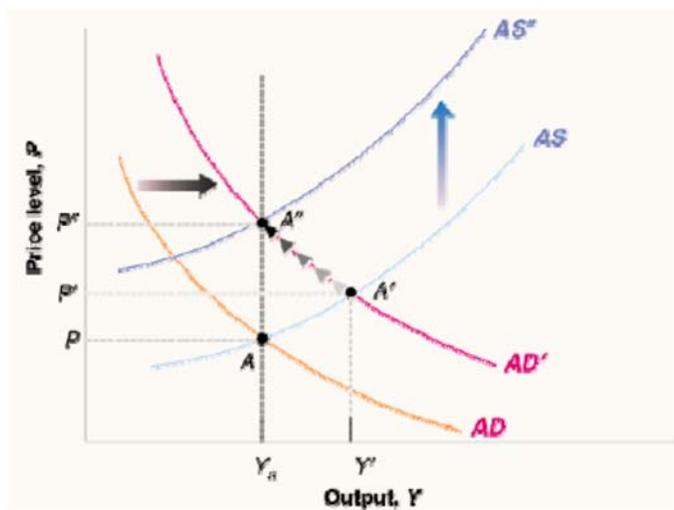
Notice the equilibrating price level (point  $A'$ ) now exceeds the new expected price level. Come the next period, the AS curve would have to shift up again. As long as output exceeds  $Y_n$ , then  $P$  will exceed the expected price level, and the AS curve will keep on shifting up, until finally equilibrium output equals  $Y_n$ . The model has a self-equilibrating character.



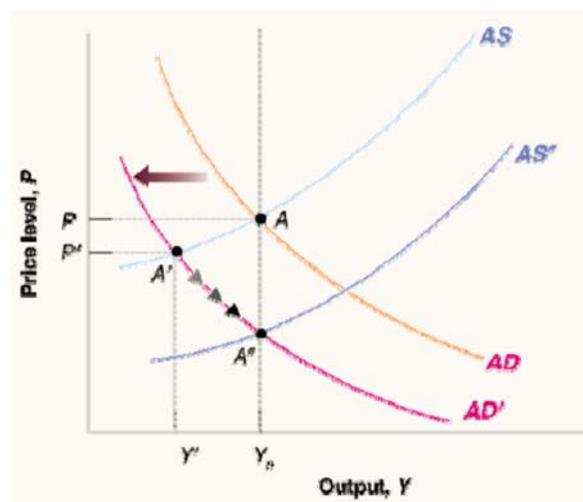
**Figure 6:** Price and output adjustment over time

### 3. Policy Effects, Short and Medium Run

Consider first a monetary expansion (Figure 7). The AD curve shifts to  $AD'$ ; equilibrium moves from point  $A$  to  $A'$  in the short run. Since output exceeds the natural rate, then the price level exceeds the expected price level, and over time, the AS curve continues to shift up, until output equals  $Y_n$  is restored. In Figure 8, a fiscal contraction is depicted. The AD curve shifts in, so equilibrium moves from  $A$  to  $A'$ . At  $A'$ , the price level is below the expected price level; hence, in the next period, the expected price level falls. This continues over time as long as output is below  $Y_n$ , shifting down the AS curve until finally reaching  $AS'$ , and restoring output to  $Y_n$  at equilibrium  $A''$ .



**Figure 7:** Response to expansionary monetary Policy



**Figure 8:** Response to contractionary fiscal policy

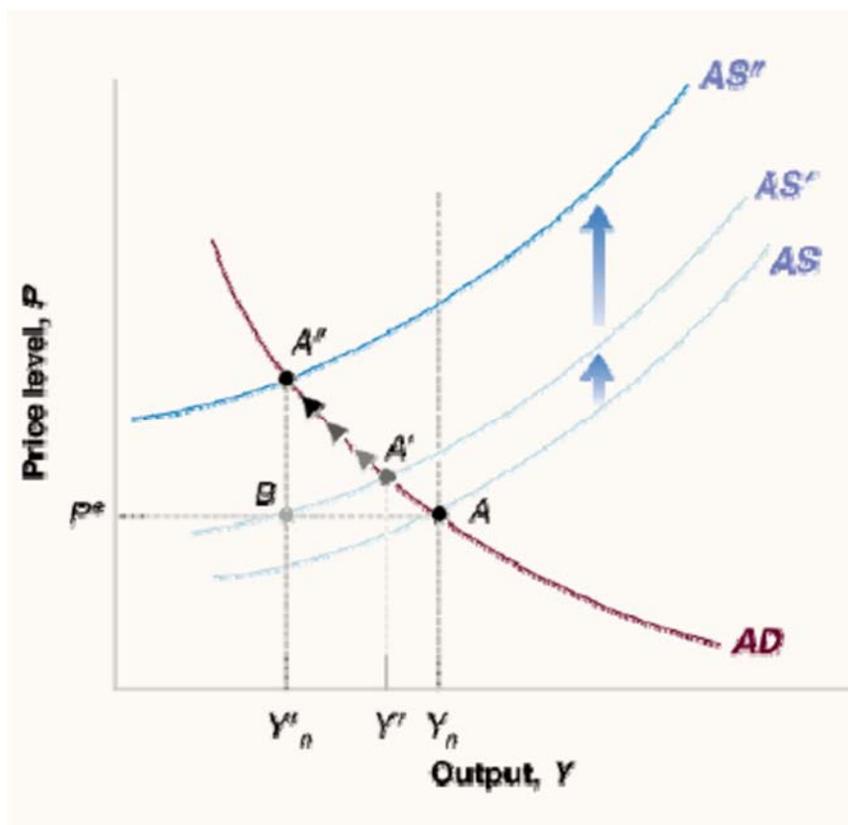
While Figures 7 and 8 appear to be direct opposites in terms of outcomes, this interpretation is not completely correct. Monetary policy (Figure 7) will in the medium run result in an unchanged *distribution* of economic activity (consumption, investment, government spending). Fiscal policy (Figure 8) would result in a changed distribution of expenditures (because there is complete crowding in by fiscal policy in the medium run). **An important point:** in the medium run when prices can fully adjust, monetary policy is neutral with respect to both the level and composition of GDP.

In Figure 7, it's useful to consider what would happen if the monetary authorities attempted to keep output at  $Y'$ . What actions would the monetary authority have to undertake? And what would happen to the price level?

### 4. Oil Shock (or other negative supply side shock)

Assume one is starting at medium run equilibrium, point  $A$ . An oil shock pushes up the AS curve (increasing the markup, in equation 5) in the short run, so equilibrium is at  $A'$ . In the medium run,  $Y_n$  decreases to  $Y'_n$ .  $Y'$  exceeds the new level of natural output, so now the AS curve continues to rise until output is restored at  $Y'_n$ , at point  $A''$ .

Notice that a supply shock results in a permanently lower level of output and a permanently higher level of the price level. Monetary and fiscal policies cannot offset these effects indefinitely. If they tried to do so, the result will be continuously rising prices.



**Figure 9:** Response to price shock

## 5. Context: Schools of Macroeconomic Thought

The model described in the textbook is sometimes called the Neoclassical Synthesis (in older language), because it is Keynesian in the short run, Classical in the medium run. A Classical model would arise if the AS curve were perfectly vertical at  $Y_n$ . A New Classical version of this model would result if  $P^e$  always equaled the  $P$  (plus or minus a random error) that sets AD to  $Y_n$ . A New Keynesian model looks a lot like this Neoclassical Synthesis, except that the AS curve shifts in part due to changes in  $P^e$ , but is constrained in part by nominal rigidities (like long term wage contracts).

E442\_ADAS\_f20 21.9.2020