LECTURE 6: PUTTING ALL MARKETS TOGETHER: THE AS-AD MODEL*

Fei Tan†

Output, interest rate, and unemployment rate are determined by simultaneous equilibrium in the goods, financial, and labor markets. This lecture integrates these three markets both in the short-run and medium-run equilibria, and consider the transition dynamics from the short run to medium run. Simultaneous equilibrium in the goods and financial markets is summarized in an aggregate demand relation; equilibrium in the labor market is summarized in an aggregate supply relation. We maintain the assumption that changes in monetary policy are discrete changes in the level of nominal money supply. Later on we will introduce money growth and inflation into the analysis and discuss the economy in terms of growth rates rather than levels of variables. (Assigned reading: section 7-6 of required textbook)

1 AGGREGATE SUPPLY

Recall that the actual price level will typically not be equal to the expected price level in the short run, though they are equal in the medium run. Based on the previous lecture, we can combine the wage- and price-setting relations in the labor market to obtain

$$P = (1+m)W = P^e(1+m)F(u,z) \tag{1.1}$$

where we assume that both m and z are constant here. Also note that

$$u = \frac{U}{L} = \frac{L-N}{L} = 1 - \frac{Y}{L} \tag{1.2}$$

where we continue to assume that production function is given by $Y = N$. That is, for a given labor force, the higher the output, the lower the unemployment rate. Combining the two equations gives the **aggregate supply relation**, or **AS relation**

$$\text{AS relation:} \quad P = P^e(1+m)F\left(1 - \frac{Y}{L}, z\right) \tag{1.3}$$

which is a relation among (P, Y, P^e) and captures the effects of output on the price level. The AS relation has two important properties:

Date: September 28, 2015.

These are notes that I used by myself to lecture from and for educational purposes only. The material presented here is largely based upon the undergraduate textbook by Blanchard and Johnson (2012), *Macroeconomics*, 6th Edition, Prentice Hall. Please do NOT circulate.

†Department of Economics, John Cook School of Business, Saint Louis University. E-mail: tanf@slu.edu

- Given expected price level, an increase in output leads to an increase in the price level. This is because an increase in output leads to an increase in employment. Higher employment implies lower unemployment and hence the unemployment rate, which leads to an increase in the nominal wage (wage-setting relation). Higher nominal wage leads in turn to higher prices set by firms (price-setting relation).
- Given unemployment, an increase in the expected price level leads, one for one, to an increase in the actual price level. This is because wage setters will set a higher nominal wage, leading to an increase in costs and hence an increase in prices set by firms.

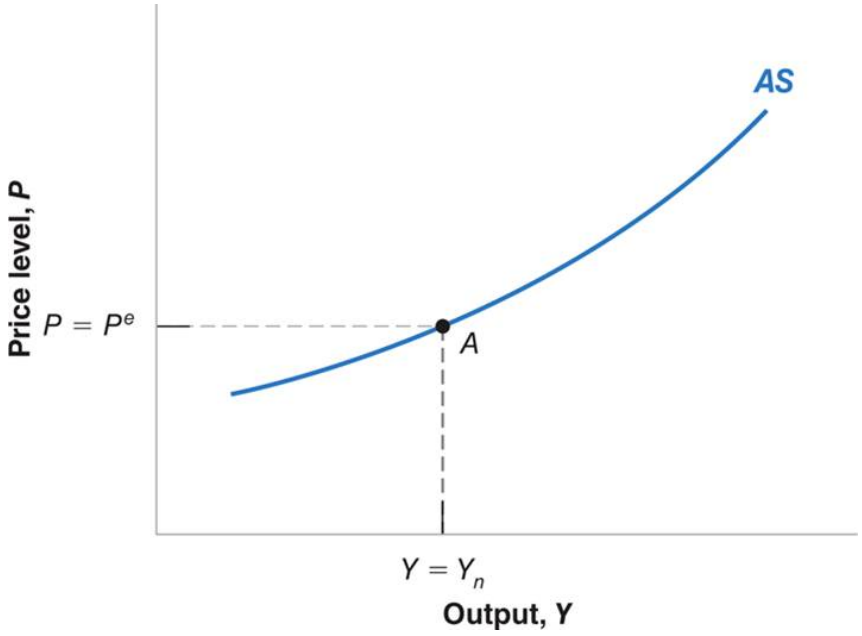

Figure 1. The aggregate supply curve

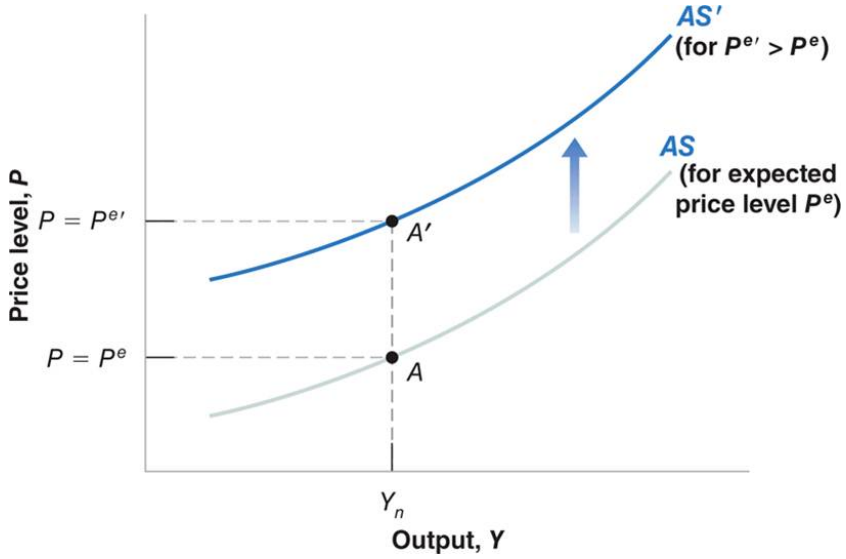

Figure 2. The effect of an increase in the expected price level on AS curve

See Figure 1 above for the relation between the price level P and output Y for a given expected price level P^e. The AS curve has three properties:

- The AS curve is upward sloping—high economic activity puts pressure on prices. (Previously we had assumed that the AS curve was flat.)
- If output Y is equal to its natural level Y_n, the price level P is equal to its expected level P^e by the definition of natural level of output.
- An increase in the expected price level shifts the AS curve up. This is because, at any given level of output and hence unemployment rate, higher expected price level leads to higher nominal wages, which leads in turn to higher prices. See Figure 2 above.

2 AGGREGATE DEMAND

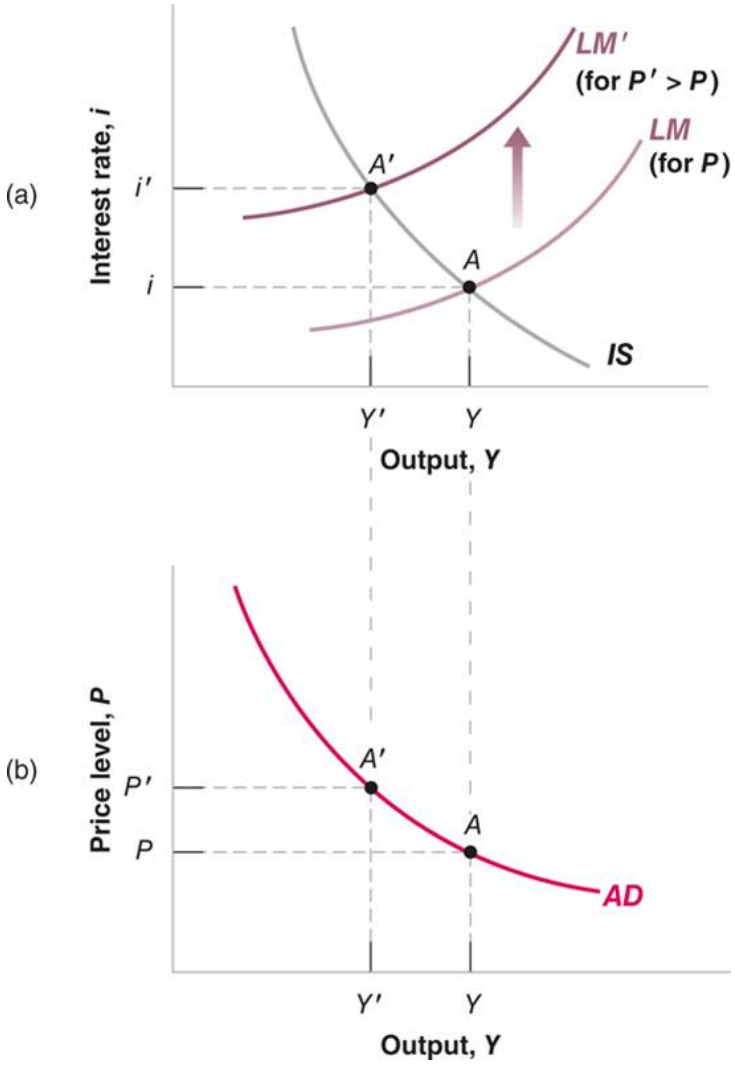

Figure 3. The derivation of the aggregate demand curve

Recall the equilibrium conditions in the goods and financial markets

$$\text{IS relation} \quad : \quad Y = C(Y - T) + I(Y, i) + G \tag{2.1}$$

$$\text{LM relation} \quad : \quad \frac{M}{P} = YL(i) \tag{2.2}$$

Using the above equations, we can derive the relation between price level P and level of output Y implied by the goods and financial markets equilibria for given monetary and fiscal policies (M, G, T).

Consider the effects of an increase in the price level. Given the stock of nominal money M, higher price level P leads to a lower real money stock M/P. As a result, the LM curve shifts up, leading to a higher interest rate. This in turn leads to a lower demand for goods and hence lower output. See Figure 3 above. The resulting negative relation between output and price level is called the **aggregate demand relation**, or **AD relation**. It captures the effect of price level on output.

We may also consider how variables other than the price level shifts the AD curve. See Figure 4 below. In sum, we can represent the aggregate demand relation as follows

$$\text{AD relation:} \quad Y = Y\underset{(+,+,-)}{\left(\frac{M}{P}, G, T\right)} \tag{2.3}$$

That is, output Y is an increasing function of the real money stock M/P and government spending G, and a decreasing function of taxes T.

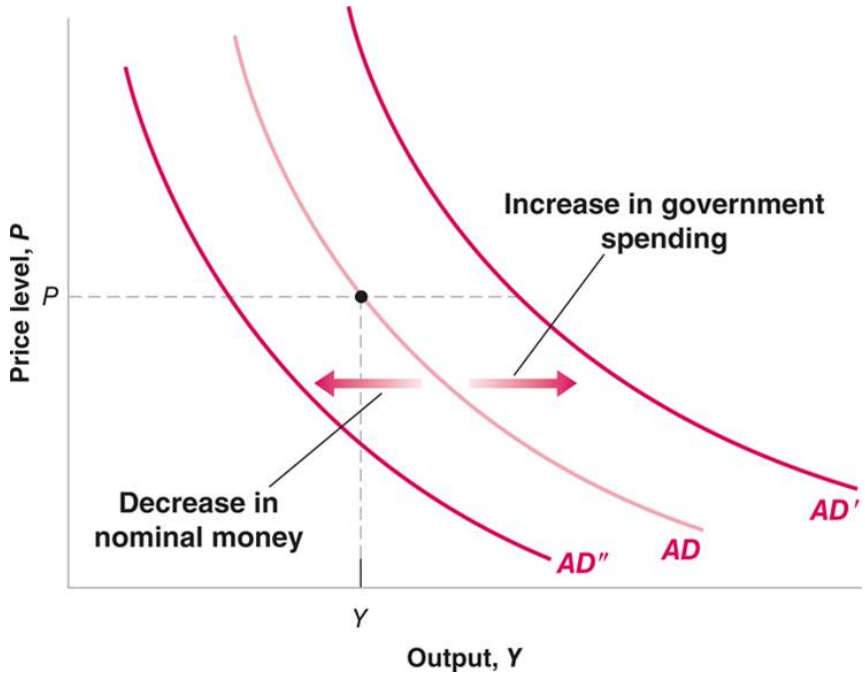

Figure 4. Shifts of the aggregate demand curve

3 EQUILIBRIUM IN THE SHORT AND MEDIUM RUN

We now put the AS and AD relations together. For given values of the expected price level P^e and the monetary and fiscal policy variables (M, G, T), these two relations determine the equilibrium output Y and price level P.

Equilibrium in the short run. The short-run equilibrium is characterized in Figure 5 below.

- The AS curve is upward sloping—the higher the level of output, the higher the price level—and its position depends on P^e.
- The AD curve is downward sloping—the higher the price level, the lower the level of output—and its position depends on (M, G, T).
- The equilibrium is given by the intersection of the AS and AD curves, where the goods, financial, and labor markets are all in equilibrium.

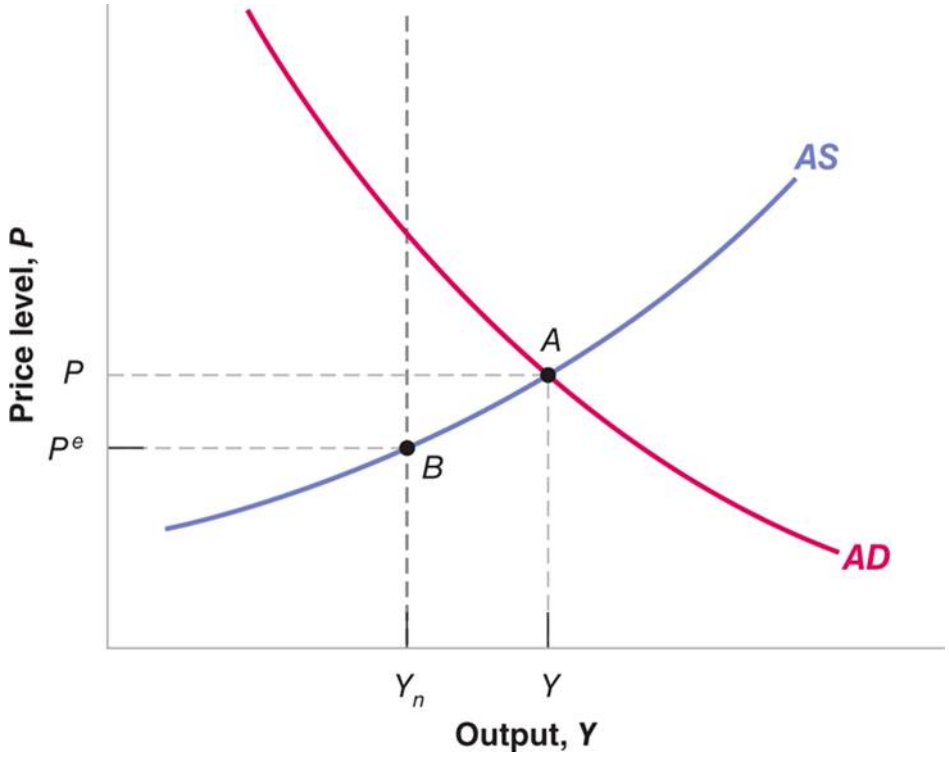

Figure 5. The short-run equilibrium

Note that in the short run, output can be either above or below its natural level. Whether it does or not depends on the specific values of P^e and (M, G, T).

From the short run to the medium run. We can also think about what happens over time. See Figure 6 below. So long as the output exceeds its natural level, the price level will be higher

than expected. This leads wage setters to revise their expectations of the price level upward in the next period. As a result, the AS curve shifts up, leading to an increase in the price level. Higher price level leads to a lower real money stock, which leads to a higher interest rate, which leads to a lower output. The adjustment stops when $Y = Y_n$ and $P = P^e$—through changes in the price level, output returns to its natural level in the medium run.

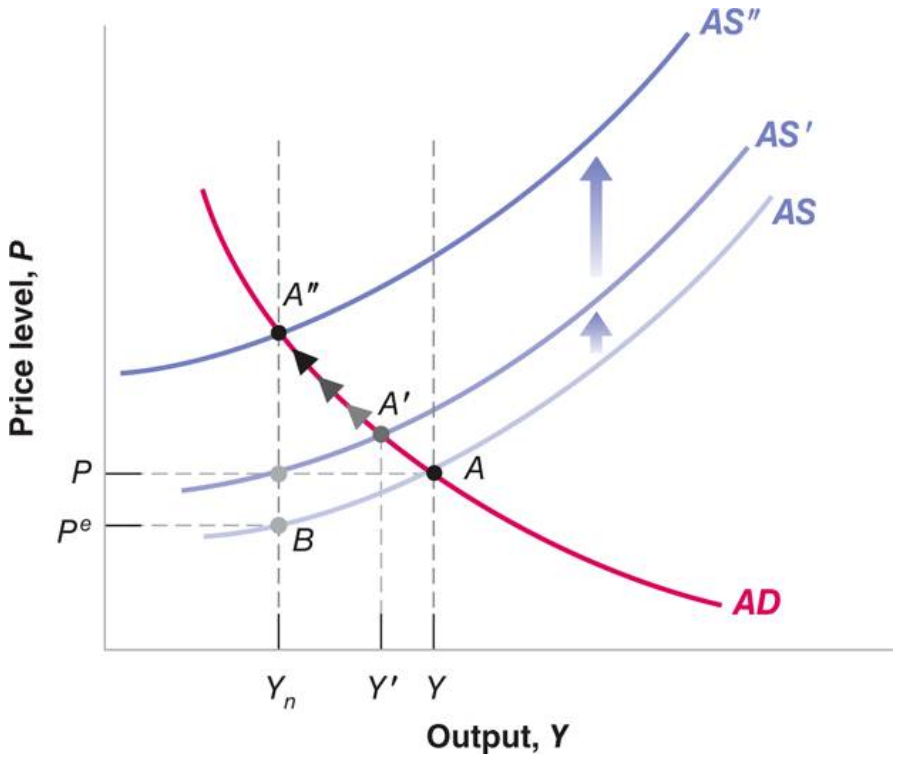

Figure 6. The adjustment of output over time

4 THE EFFECTS OF A MONETARY EXPANSION

The dynamics of adjustment. We consider the short and medium run effects of an expansionary monetary policy (e.g. one-time increase in the nominal money stock) in terms of both the AS-AD model and the IS-LM model. See Figure 7 below.

- In the short run, for a given price level, higher nominal money leads to higher real money and hence higher output. The AD curve shifts to the right: both output and price level increase. Moreover, the LM curve shifts down: interest rate is lower and output is higher. Note that the higher price level partly offsets the effect of initial increase in nominal money.
- Over time, the fact that output is above its natural level implies that the price level continues to increase, which further reduces the real money stock. The AS curve shifts up and the LM curve shifts back up.

- In the medium run, output returns to its natural level and interest rate increases to its initial value. Moreover, prices increase in proportion to the increase in nominal money stock. Thus, the real money stock is eventually unchanged.

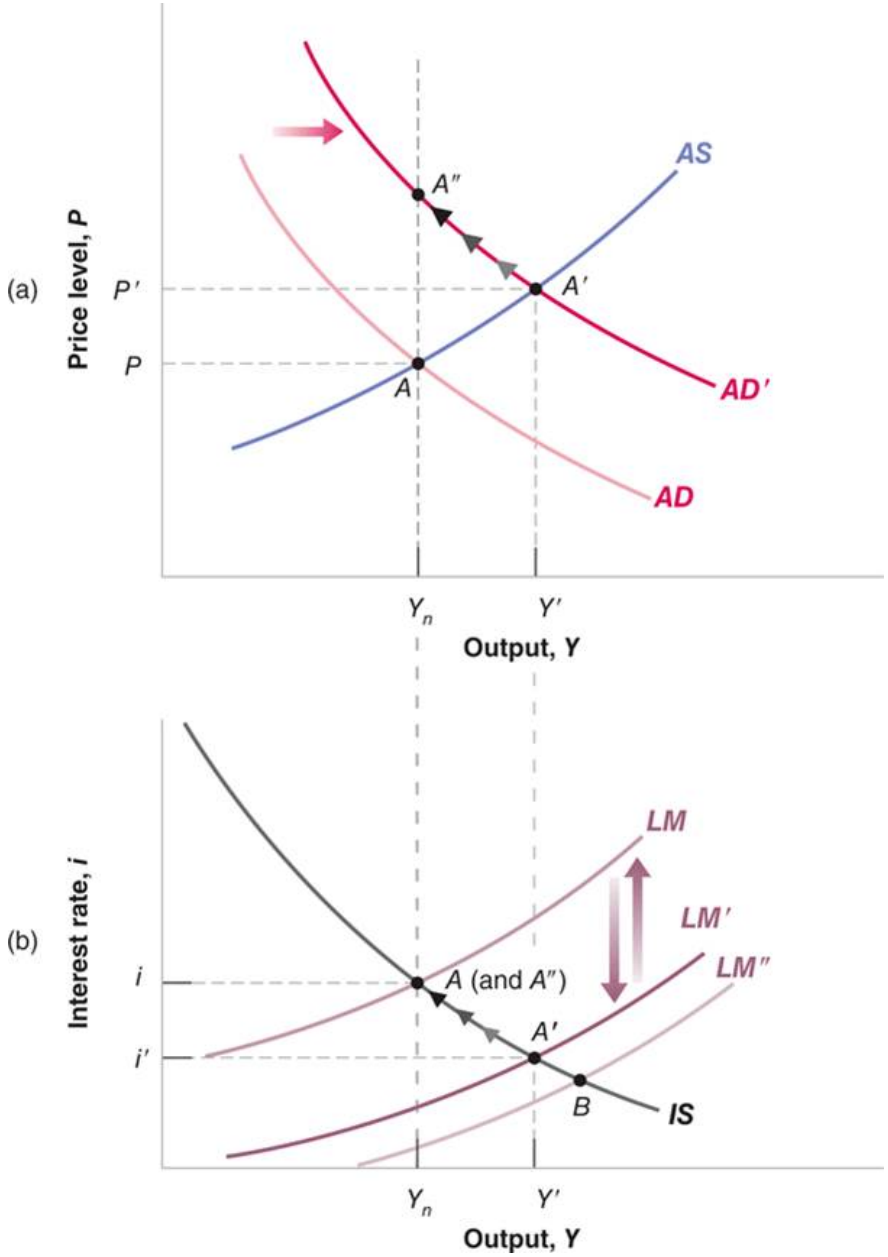

Figure 7. The dynamic effects of monetary expansion on output and interest rate

The neutrality of money. In the short run, a monetary expansion leads to higher output, lower interest rate, and higher price level. In the medium run, the increase in nominal money is reflected entirely in a proportional increase in the price level, eliminating the effect of monetary expansion on output and interest rate. The absence of medium-run effect of money on output and interest rate is called the **neutrality of money**.

5 A DECREASE IN THE BUDGET DEFICIT

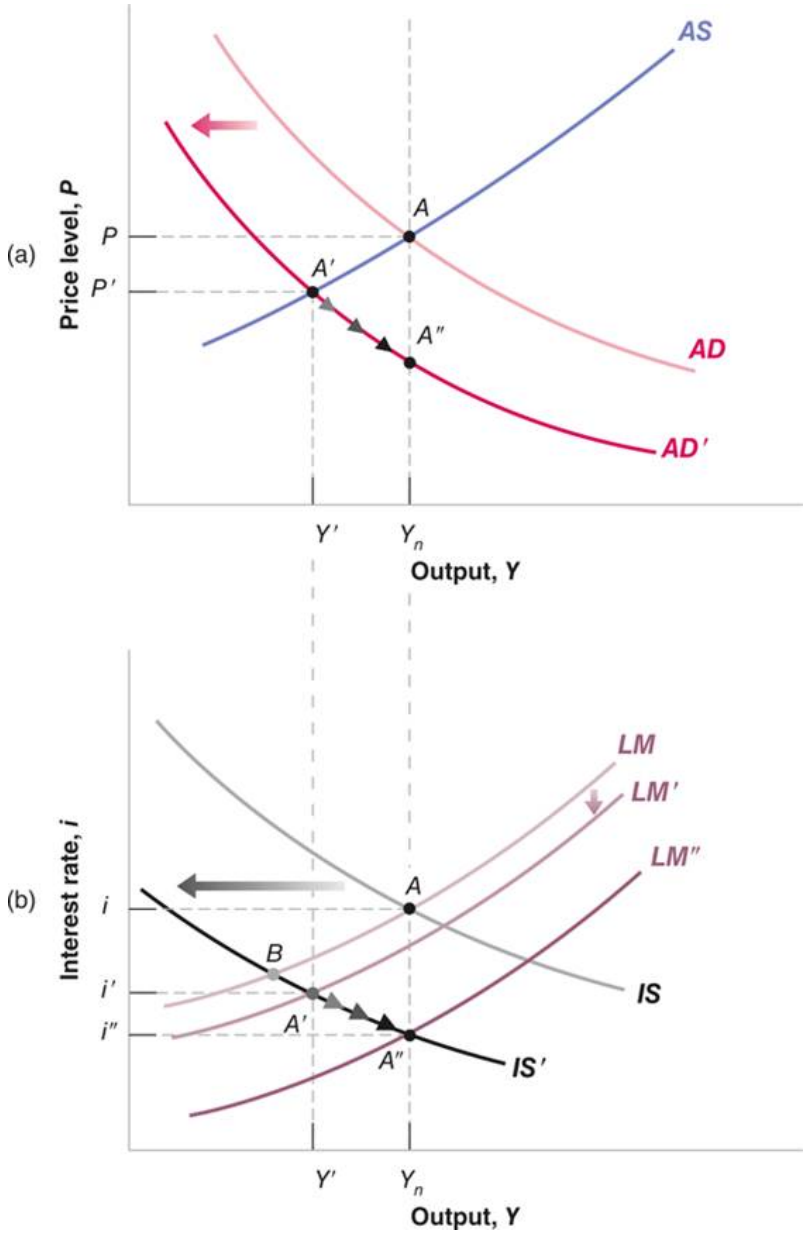

Figure 8. The dynamic effects of fiscal contraction on output and interest rate

Deficit reduction, output, and the interest rate. We consider the short and medium run effects of a contractionary fiscal policy (e.g. decrease in government spending while leaving taxes unchanged) in terms of both the AS-AD model and the IS-LM model. See Figure 8 above.

- In the short run, for a given price level, lower budget deficit leads to lower demand and hence lower output. The AD curve shifts to the left: both output and price level decrease. Moreover, the IS curve shifts to the left: both interest rate and output are

lower. Note that the lower price level partly offsets the effect of initial decrease in budget deficit.

- Over time, the fact that output is below its natural level implies that the price level continues to decrease, which further increases the real money stock. Both the AS curve and the LM curve shift down.

- In the medium run, output returns to its natural level but interest rate falls lower than it was before the deficit reduction. To see how the composition of output changes, write the IS relation as

$$Y_n = C(Y_n - T) + I(Y_n, i) + G \tag{5.1}$$

where Y_n and T are unchanged and so is consumption C. As a result, investment I must rise by an amount equal to the decrease in G. This is in sharp contrast to the short run effect of fiscal contraction we discussed earlier.

Budget deficits, output, and investment. In the short run, a deficit reduction, without an accompanying monetary expansion, leads to lower output but the change in investment remains ambiguous. In the medium run, a deficit reduction leads unambiguously to higher investment. In the long run, a deficit reduction leads to more investment and hence higher capital stock, which in turn leads to higher output.

6 CONCLUSIONS

One key message of this lecture is that changes in policy typically have different effects in the short and medium run. See Table 1 below. Disagreement among economists about the policy effects often come from differences in the time frame they have in mind, and where they stand depends in particular on how fast they think the economy adjusts to shocks.

	Short Run			Medium Run		
	Output Level	Interest Rate	Price Level	Output Level	Interest Rate	Price Level
Monetary expansion	increase	decrease	increase (small)	no change	no change	increase
Deficit reduction	decrease	decrease	decrease (small)	no change	decrease	decrease

Table 1. The policy effects in the short and long run