

Chapter 2

Monetary Policy B

1. The Model

The model of unemployment and inflation can be characterized by a system of two equations:

$$u = A - \alpha M \quad (1)$$

$$\pi = B + \alpha \varepsilon M \quad (2)$$

The targets of the European central bank are zero inflation and zero unemployment in Europe. The instrument of the European central bank is European money supply. There are two targets but only one instrument, so what is needed is a loss function. We assume that the European central bank has a quadratic loss function:

$$L_1 = \pi^2 + u^2 \quad (3)$$

L_1 is the loss to the European central bank caused by inflation and unemployment. For ease of exposition we assume equal weights in the loss function. The specific target of the European central bank is to minimize the loss, given the inflation function and the unemployment function. Taking account of equations (1) and (2), the loss function of the European central bank can be written as follows:

$$L_1 = (B + \alpha \varepsilon M)^2 + (A - \alpha M)^2 \quad (4)$$

Then the first-order condition for a minimum loss is:

$$M = \frac{A - \varepsilon B}{\alpha + \alpha \varepsilon^2} \quad (5)$$

Here M is the optimum level of European money supply. An increase in A requires an increase in European money supply. And an increase in B requires a cut in European money supply. From equations (1) and (5) follows the optimum rate of unemployment in Europe:

$$u = \frac{\varepsilon^2 A + \varepsilon B}{1 + \varepsilon^2} \quad (6)$$

And from equations (2) and (5) follows the optimum rate of inflation in Europe:

$$\pi = \frac{\varepsilon A + B}{1 + \varepsilon^2} \quad (7)$$

The comparison of equations (6) and (7) gives:

$$u = \varepsilon \pi \quad (8)$$

Unemployment in Europe is not zero, nor is inflation there.

2. Some Numerical Examples

For ease of exposition we assume that monetary policy multipliers are unity $\alpha = \varepsilon = 1$. On this assumption, the model of unemployment and inflation can be written as follows:

$$u = A - M \quad (1)$$

$$\pi = B + M \quad (2)$$

A unit increase in money supply lowers the rate of unemployment by 1 percentage point. On the other hand, it raises the rate of inflation by 1 percentage point. The model can be solved this way:

$$2M = A - B \quad (3)$$

$$2u = A + B \quad (4)$$

$$2\pi = A + B \quad (5)$$

Equation (3) shows the optimum level of money supply, equation (4) shows the optimum rate of unemployment, and equation (5) shows the optimum rate of inflation.

It proves useful to study four distinct cases:

- a demand shock in Europe
- a supply shock in Europe
- a mixed shock in Europe
- another mixed shock in Europe.

1) A demand shock in Europe. Let initial unemployment be zero, and let initial inflation be zero as well. Step one refers to a decline in aggregate demand. In terms of the model there is an increase in A of 2 units and a decline in B of equally 2 units. Step two refers to the outside lag. Unemployment goes from zero to 2 percent. And inflation goes from zero to -2 percent. Step three refers to the policy response. What is needed, according to the model, is an increase in money

supply of 2 units. Step four refers to the outside lag. Unemployment goes from 2 to zero percent. And inflation goes from -2 to zero percent. Table 1.3 presents a synopsis.

As a result, given a demand shock, monetary policy can achieve both zero inflation and zero unemployment. The loss function of the central bank is:

$$L_1 = \pi^2 + u^2 \quad (6)$$

The initial loss is zero. The demand shock causes a loss of 8 units. Then monetary policy can reduce the loss to zero.

Table 1.3
Monetary Policy in Europe
A Demand Shock

Unemployment	0	Inflation	0
Shock in A	2	Shock in B	-2
Unemployment	2	Inflation	-2
Change in Money Supply	2		
Unemployment	0	Inflation	0

2) A supply shock in Europe. Let initial unemployment and inflation be zero each. Step one refers to the supply shock. In terms of the model there is an increase in B of 2 units and an increase in A of equally 2 units. Step two refers to the outside lag. Inflation goes from zero to 2 percent. And unemployment goes from zero to 2 percent as well. Step three refers to the policy response. What is needed, according to the model, is to hold money supply constant. Step four refers to the outside lag. Obviously, inflation stays at 2 percent, and unemployment stays at 2 percent as well. Table 1.4 gives an overview.

As a result, given a supply shock, monetary policy is ineffective. The supply shock causes a loss of 8 units. However, monetary policy cannot reduce the loss.

Table 1.4
Monetary Policy in Europe
 A Supply Shock

Unemployment	0	Inflation	0
Shock in A	2	Shock in B	2
Unemployment	2	Inflation	2
Change in Money Supply	0		
Unemployment	2	Inflation	2

3) A mixed shock in Europe. Let initial unemployment and inflation be zero each. Step one refers to the mixed shock. In terms of the model there is an increase in B of 2 units. Step two refers to the outside lag. Inflation goes from zero to 2 percent. And unemployment stays at zero percent. Step three refers to the policy response. What is needed, according to the model, is a reduction in money supply of 1 unit. Step four refers to the outside lag. Inflation goes from 2 to 1 percent. And unemployment goes from zero to 1 percent. For a synopsis see Table 1.5.

As a result, given a mixed shock, monetary policy can reduce the loss caused by inflation and unemployment. However, it cannot achieve zero inflation and zero unemployment. The mixed shock causes a loss of 4 units. Then monetary policy can reduce the loss to 2 units.

4) Another mixed shock in Europe. Let initial unemployment and inflation be zero each. Step one refers to the mixed shock. In terms of the model there is an increase in A of 2 units. Step two refers to the outside lag. Unemployment goes from zero to 2 percent. And inflation stays at zero percent. Step three refers to the policy response. What is needed, according to the model, is an increase in money

supply of 1 unit. Step four refers to the outside lag. Unemployment goes from 2 to 1 percent. And inflation goes from zero to 1 percent. For an overview see Table 1.6.

As a result, given a mixed shock, monetary policy can reduce the loss caused by inflation and unemployment to a certain extent. The mixed shock causes a loss of 4 units. Then monetary policy can reduce the loss to 2 units.

Table 1.5
Monetary Policy in Europe
A Mixed Shock

Unemployment	0	Inflation	0
Shock in A	0	Shock in B	2
Unemployment	0	Inflation	2
Change in Money Supply	– 1		
Unemployment	1	Inflation	1

Table 1.6
Monetary Policy in Europe
Another Mixed Shock

Unemployment	0	Inflation	0
Shock in A	2	Shock in B	0
Unemployment	2	Inflation	0
Change in Money Supply	1		
Unemployment	1	Inflation	1

5) Summary. Given a demand shock, monetary policy can achieve both zero inflation and zero unemployment. Given a supply shock, monetary policy is ineffective. Given a mixed shock, monetary policy can reduce the loss caused by inflation and unemployment. However, it cannot achieve zero inflation and zero unemployment.

6) Comparing cases A and B. As to the policy targets there are two distinct cases. In case A, by definition, the target of the central bank is zero inflation. In case B, by definition, the targets of the central bank are zero inflation and zero unemployment. First consider a demand shock. In case A, given a demand shock, monetary policy can achieve zero inflation. And what is more, as a side effect, it can achieve zero unemployment. In case B, given a demand shock, monetary policy can achieve both zero inflation and zero unemployment. Second consider a supply shock. In case A, given a supply shock, monetary policy can achieve zero inflation. However, as a side effect, it causes an increase in unemployment. In case B, given a supply shock, monetary policy is ineffective.



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Strategic Policy Interactions in a Monetary Union

Carlberg, M.

2009, XVI, 256 p., Hardcover

ISBN: 978-3-540-92750-1