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Preface

This book studies the dynamic interactions between monetary and fiscal policies in a world economy. The world economy consists of two monetary regions, say Europe and America. The policy makers are the central banks and the governments. The primary target of a central bank is low inflation. And the primary target of a government is low unemployment. However, there is a short-run trade-off between low inflation and low unemployment. Here the main focus is on cold-turkey policies. Another focus is on gradualist policies. And a third focus is on policy cooperation. There are demand shocks, supply shocks, and mixed shocks. There are regional shocks and common shocks. The key question is: Given a shock, what are the dynamic characteristics of the resulting process?

The present book is part of a larger research project on European Monetary Union, see The Current Research Project (pp. 265 - 269) and the References (especially p. 274). In principle there are two approaches. One approach is to study the Nash equilibrium. Another approach is to study dynamic interactions. The present book deals with dynamic interactions.

Some parts of this project were presented at the World Congress of the International Economic Association, at the International Conference on Macroeconomic Analysis, at the International Institute of Public Finance, and at the International Atlantic Economic Conference. Other parts were presented at the Macro Study Group of the German Economic Association, at the Annual Meeting of the Austrian Economic Association, at the Göttingen Workshop on International Economics, at the Halle Workshop on Monetary Economics, at the Research Seminar on Macroeconomics in Freiburg, at the Research Seminar on Economics in Kassel, and at the Passau Workshop on International Economics.

Over the years, in working on this project, I have benefited from comments by Iain Begg, Michael Bräuninger, Volker Clausen, Valeria de Bonis, Peter Flaschel, Helmut Frisch, Wilfried Fuhrmann, Franz X. Hof, Florence Huart, Oliver Landmann, Jay H. Levin, Alfred Maußner, Jochen Michaelis, Reinhard Neck, Manfred J. M. Neumann, Klaus Neusser, Franco Reither, Armin Rohde,

Executive Summary

1) Monetary and fiscal interaction between Europe and America. The target of the European central bank is zero inflation in Europe. The target of the American central bank is zero inflation in America. The target of the European government is zero unemployment in Europe. And the target of the American government is zero unemployment in America. One, consider a common demand shock. In that case, monetary and fiscal interaction causes uniform oscillations in unemployment and inflation. And what is more, there are uniform oscillations in money supply and government purchases. Two, consider a common supply shock. In that case, monetary and fiscal interaction causes uniform oscillations in unemployment and inflation. And what is more, there is an explosion of government purchases and an implosion of money supply.

Three, consider a demand shock in Europe. In that case, monetary and fiscal interaction causes uniform oscillations in European unemployment and European inflation. And what is more, there are uniform oscillations in European money supply and European government purchases. Another result is that monetary and fiscal interaction has no effects on the American economy. Four, consider a supply shock in Europe. In that case, monetary and fiscal interaction has no effects on European unemployment and European inflation. And what is more, there is an explosion of European government purchases and an implosion of European money supply. Another result is that monetary and fiscal interaction causes uniform oscillations in American unemployment and American inflation. And what is more, there is an implosion of both American money supply and American government purchases.

2) Monetary and fiscal cooperation between Europe and America. The targets of policy cooperation are zero inflation in Europe, zero inflation in America, zero unemployment in Europe, and zero unemployment in America. One, consider a common demand shock. In that case, monetary and fiscal cooperation produces zero unemployment and zero inflation in each of the regions. There is an increase in money supply or government purchases or both of them. There is a cut in unemployment. And there is a cut in deflation. Two,

consider a common supply shock. In that case, monetary and fiscal cooperation has no effects on unemployment and inflation. There is no change in money supply and government purchases.

Three, consider a demand shock in Europe. In that case, monetary and fiscal cooperation produces zero unemployment and zero inflation in each of the regions. There is an increase in European and American money supply. There is a cut in European unemployment. And there is a cut in European deflation. Four, consider a supply shock in Europe. In that case, monetary and fiscal cooperation has no effects on unemployment and inflation. There is no change in money supply and government purchases.

3) Comparing policy interaction with policy cooperation. Judging from this point of view, policy cooperation seems to be superior to policy interaction.

Contents in Brief

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Introduction

1. Subject and Approach

This book studies the interactions between monetary and fiscal policies in a world economy. Here the focus is on a dynamic analysis. The world economy consists of two monetary regions, say Europe and America. The policy makers are the European central bank, the American central bank, the European government, and the American government. The central banks are independent. There is a short-run trade-off between unemployment and inflation. In other words, there is a short-run Phillips curve.

1) The static model. An increase in European money supply lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American money supply lowers American unemployment. On the other hand, it raises American inflation. An essential point is that monetary policy in Europe has spillover effects on America and vice versa. An increase in European money supply raises American unemployment and lowers American inflation. Similarly, an increase in American money supply raises European unemployment and lowers European inflation.

An increase in European government purchases lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American government purchases lowers American unemployment. On the other hand, it raises American inflation. An essential point is that fiscal policy in Europe has spillover effects on America and vice versa. An increase in European government purchases lowers American unemployment and raises American inflation. Similarly, an increase in American government purchases lowers European unemployment and raises European inflation.

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. The amount of loss depends on inflation and unemployment in Europe. The European central bank sets European money supply so as to minimize its loss. From this follows the reaction function of the European central bank.

The targets of the American central bank are zero inflation and zero unemployment in America. The instrument of the American central bank is American money supply. There are two targets but only one instrument, so what needed is a loss function. We assume that the American central bank has a quadratic loss function. The amount of loss depends on inflation and unemployment in America. The American central bank sets American money supply so as to minimize its loss. From this follows the reaction function of the American central bank.

The target of the European government is zero unemployment in Europe. The instrument of the European government is European government purchases. From this follows the reaction function of the European government. The target of the American government is zero unemployment in America. The instrument of the American government is American government purchases. From this follows the reaction function of the American government.

In principle, the Nash equilibrium is determined by the reaction functions of the European central bank, the American central bank, the European government, and the American government. In the present case, however, there is no Nash equilibrium.

2) The dynamic model. We assume that the central banks and the governments decide simultaneously and independently. Step 1 refers to a specific shock. Step 2 refers to the time lag. Step 3 refers to monetary and fiscal policies. Step 4 refers to the time lag. Step 5 refers to monetary and fiscal policies. Step 6 refers to the time lag. And so on. The key questions are: Given a specific shock, can the process of simultaneous and independent policy decisions reduce the existing loss? And to what extent can it do so? To illustrate this process there are some numerical examples.

3) This book consists of six major parts:
- Monetary Interaction

4) The current research project. The present book is part of a larger research project on European Monetary Union, see The Current Research Project (pp. 265 - 269) and the References (especially p. 274). In principle there are two approaches. One approach is to study the Nash equilibrium. Another approach is to study dynamic interactions. The present book deals with dynamic interactions.

2. Monetary Interaction between Europe and America

1) The static model. An increase in European money supply lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American money supply lowers American unemployment. On the other hand, it raises American inflation. An essential point is that monetary policy in Europe has spillover effects on America and vice versa. An increase in European money supply raises American unemployment and lowers American inflation. Similarly, an increase in American money supply raises European unemployment and lowers European inflation.

The target of the European central bank is zero inflation in Europe. The instrument of the European central bank is European money supply. From this follows the reaction function of the European central bank. Suppose the

American central bank lowers American money supply. Then, as a response, the European central bank lowers European money supply. The target of the American central bank is zero inflation in America. The instrument of the American central bank is American money supply. From this follows the reaction function of the American central bank. Suppose the European central bank lowers European money supply. Then, as a response, the American central bank lowers American money supply.

2) The dynamic model. We assume that the European central bank and the American central bank decide simultaneously and independently. Step 1 refers to a specific shock. Step 2 refers to the time lag. Step 3 refers to monetary policies in Europe and America. Step 4 refers to the time lag. Step 5 refers to monetary policies in Europe and America. Step 6 refers to the time lag. And so on.

Now have a closer look at the dynamic model. Step 1 refers to a specific shock. This could be a demand shock, a supply shock or a mixed shock, in Europe or America. Step 2 refers to the time lag. This includes both the inside lag and the outside lag. In step 3, the central banks decide simultaneously and independently. The European central bank sets European money supply so as to achieve zero inflation in Europe. And the American central bank sets American money supply so as to achieve zero inflation in America. Step 4 refers to the time lag.

In step 5, the central banks decide simultaneously and independently. The European central bank sets European money supply so as to achieve zero inflation in Europe. And the American central bank sets American money supply so as to achieve zero inflation in America. Step 6 refers to the time lag. And so on. Then what are the dynamic characteristics of this process?

3. Monetary Cooperation between Europe and America

The policy makers are the European central bank and the American central bank. The targets of monetary cooperation are zero inflation in Europe and America. The instruments of monetary cooperation are European money supply and American money supply. There are two targets and two instruments. We assume that the European central bank and the American central bank agree on a common loss function. The amount of loss depends on inflation in Europe and America. The policy makers set European money supply and American money supply so as to minimize the common loss.

The cooperative equilibrium is determined by the first-order conditions for a minimum loss. It yields the optimum levels of European money supply and American money supply. The key questions are: Given a specific shock, can monetary cooperation reduce the existing loss? And is monetary cooperation superior to monetary interaction?

4. Fiscal Interaction between Europe and America

1) The static model. An increase in European government purchases lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American government purchases lowers American unemployment. On the other hand, it raises American inflation. An essential point is that fiscal policy in Europe has spillover effects on America and vice versa. An increase in European government purchases lowers American unemployment and raises American inflation. Similarly, an increase in American government purchases lowers European unemployment and raises European inflation.

The target of the European government is zero unemployment in Europe. The instrument of the European government is European government purchases. From this follows the reaction function of the European government. Suppose the American government raises American government purchases. Then, as a response, the European government lowers European government purchases. The target of the American government is zero unemployment in America. The instrument of the American government is American government purchases. From this follows the reaction function of the American government. Suppose the European government raises European government purchases. Then, as a response, the American government lowers American government purchases.

2) The dynamic model. We assume that the European government and the American government decide simultaneously and independently. Step 1 refers to a specific shock. Step 2 refers to the time lag. Step 3 refers to fiscal policies in Europe and America. Step 4 refers to the time lag. Step 5 refers to fiscal policies in Europe and America. Step 6 refers to the time lag. And so on.

Now take a closer look at the dynamic model. Step 1 refers to a specific shock. This could be a demand shock, a supply shock or a mixed shock, in Europe or America. Step 2 refers to the time lag. This includes both the inside lag and the outside lag. In step 3, the governments decide simultaneously and independently. The European government sets its purchases of European goods so as to achieve zero unemployment in Europe. And the American government sets its purchases of American goods so as to achieve zero unemployment in America. Step 4 refers to the time lag.

In step 5, the governments decide simultaneously and independently. The European government sets its purchases of European goods so as to achieve zero unemployment in Europe. And the American government sets its purchases of American goods so as to achieve zero unemployment in America. Step 6 refers to the time lag. And so on. Then what are the dynamic characteristics of this process?

5. Fiscal Cooperation between Europe and America

The policy makers are the European government and the American government. The targets of fiscal cooperation are zero unemployment in Europe and America. The instruments of fiscal cooperation are European government purchases and American government purchases. There are two targets and two instruments. We assume that the European government and the American government agree on a common loss function. The amount of loss depends on unemployment in Europe and America. The policy makers set European government purchases and American government purchases so as to minimize the common loss.

The cooperative equilibrium is determined by the first-order conditions for a minimum loss. It yields the optimum levels of European government purchases and American government purchases. The key questions are: Given a specific shock, can fiscal cooperation reduce the existing loss? And is fiscal cooperation superior to fiscal interaction?

6. Monetary and Fiscal Interaction
between Europe and America

1) The static model. An increase in European money supply lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American money supply lowers American unemployment. On the other hand, it raises American inflation. An essential point is that monetary policy in Europe has spillover effects on America and vice versa. An increase in European money supply raises American unemployment and lowers American inflation. Similarly, an increase in American money supply raises European unemployment and lowers European inflation.

An increase in European government purchases lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American government purchases lowers American unemployment. On the other hand, it raises American inflation. An essential point is that fiscal policy in Europe has spillover effects on America and vice versa. An increase in European government purchases lowers American unemployment and raises American inflation. Similarly, an increase in American government purchases lowers European unemployment and raises European inflation.

The target of the European central bank is zero inflation in Europe. The instrument of the European central bank is European money supply. From this follows the reaction function of the European central bank. Suppose the American central bank lowers American money supply. Then, as a response, the European central bank lowers European money supply. Suppose the European government raises European government purchases. Then, as a response, the European central bank lowers European money supply. Suppose the American government raises American government purchases. Then, as a response, the European central bank lowers European money supply.

The target of the American central bank is zero inflation in America. The instrument of the American central bank is American money supply. From this follows the reaction function of the American central bank. The target of the European government is zero unemployment in Europe. The instrument of the European government is European government purchases. From this follows the reaction function of the European government. The target of the American government is zero unemployment in America. The instrument of the American government is American government purchases. From this follows the reaction function of the American government.

2) The dynamic model. We assume that the central banks and the governments decide simultaneously and independently. Step 1 refers to a specific shock. Step 2 refers to the time lag. Step 3 refers to monetary and fiscal policies in Europe and America. Step 4 refers to the time lag. Step 5 refers to monetary and fiscal policies in Europe and America. Step 6 refers to the time lag. And so on.

Now have a closer look at the dynamic model. Step 1 refers to a specific shock. This could be a demand shock, a supply shock or a mixed shock, in Europe or America. Step 2 refers to the time lag. This includes both the inside lag and the outside lag. In step 3, the central banks and the governments decide simultaneously and independently. The European central bank sets European money supply so as to achieve zero inflation in Europe. And the American central bank sets American money supply so as to achieve zero inflation in America. The European government sets its purchases of European goods so as to achieve zero unemployment in Europe. And the American government sets its purchases of American goods so as to achieve zero unemployment in America. Step 4 refers to the time lag.

In step 5, the central banks and the governments decide simultaneously and independently. The European central bank sets European money supply so as to achieve zero inflation in Europe. And the American central bank sets American money supply so as to achieve zero inflation in America. The European government sets its purchases of European goods so as to achieve zero unemployment in Europe. And the American government sets its purchases of American goods so as to achieve zero unemployment in America. Step 6 refers to the time lag. And so on. Then what are the dynamic characteristics of this process?

7. Monetary and Fiscal Cooperation between Europe and America

The policy makers are the European central bank, the American central bank, the European government, and the American government. The targets of policy cooperation are zero inflation in Europe, zero inflation in America, zero unemployment in Europe, and zero unemployment in America. The instruments of policy cooperation are European money supply, American money supply, European government purchases, and American government purchases. There are four targets and four instruments. We assume that the policy makers agree on

a common loss function. The amount of loss depends on inflation and unemployment in each of the regions. The policy makers set European money supply, American money supply, European government purchases, and American government purchases so as to minimize the common loss.

The cooperative equilibrium is determined by the first-order conditions for a minimum loss. It yields the optimum levels of European money supply, American money supply, European government purchases, and American government purchases. The key questions are: Given a specific shock, can monetary and fiscal cooperation reduce the existing loss? And is policy cooperation superior to policy interaction?

Part One

Monetary Interaction between Europe and America

Chapter 1
Monetary Interaction: Case A

1. The Model

1) The static model. The world economy consists of two monetary regions, say Europe and America. The monetary regions are the same size and have the same behavioural functions. This chapter is based on target system A. The target of the European central bank is zero inflation in Europe. And the target of the American central bank is zero inflation in America.

An increase in European money supply lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American money supply lowers American unemployment. On the other hand, it raises American inflation. An essential point is that monetary policy in Europe has spillover effects on America and vice versa. An increase in European money supply raises American unemployment and lowers American inflation. Similarly, an increase in American money supply raises European unemployment and lowers European inflation.

The model of unemployment and inflation can be represented by a system of four equations:

$$u_1 = A_1 - M_1 + 0.5M_2 \tag{1}$$

$$u_2 = A_2 - M_2 + 0.5M_1 \tag{2}$$

$$\pi_1 = B_1 + M_1 - 0.5M_2 \tag{3}$$

$$\pi_2 = B_2 + M_2 - 0.5M_1 \tag{4}$$

Here u_1 denotes the rate of unemployment in Europe, u_2 is the rate of unemployment in America, π_1 is the rate of inflation in Europe, π_2 is the rate of inflation in America, M_1 is European money supply, M_2 is American money supply, A_1 is some other factors bearing on the rate of unemployment in Europe, A_2 is some other factors bearing on the rate of unemployment in America, B_1 is

some other factors bearing on the rate of inflation in Europe, and B_2 is some other factors bearing on the rate of inflation in America. The endogenous variables are the rate of unemployment in Europe, the rate of unemployment in America, the rate of inflation in Europe, and the rate of inflation in America.

According to equation (1), European unemployment is a positive function of A_1, a negative function of European money supply, and a positive function of American money supply. According to equation (2), American unemployment is a positive function of A_2, a negative function of American money supply, and a positive function of European money supply. According to equation (3), European inflation is a positive function of B_1, a positive function of European money supply, and a negative function of American money supply. According to equation (4), American inflation is a positive function of B_2, a positive function of American money supply, and a negative function of European money supply.

Now consider the direct effects. According to the model, an increase in European money supply lowers European unemployment. On the other hand, it raises European inflation. Correspondingly, an increase in American money supply lowers American unemployment. On the other hand, it raises American inflation. Then consider the spillover effects. According to the model, an increase in European money supply raises American unemployment and lowers American inflation. Similarly, an increase in American money supply raises European unemployment and lowers European inflation.

According to the model, a unit increase in European money supply lowers European unemployment by 1 percentage point. On the other hand, it raises European inflation by 1 percentage point. And what is more, a unit increase in European money supply raises American unemployment by 0.5 percentage points and lowers American inflation by 0.5 percentage points. For instance, let European unemployment be 2 percent, and let European inflation be 2 percent as well. Further, let American unemployment be 2 percent, and let American inflation be 2 percent as well. Now consider a unit increase in European money supply. Then European unemployment goes from 2 to 1 percent. On the other hand, European inflation goes from 2 to 3 percent. And what is more, American unemployment goes from 2 to 2.5 percent, and American inflation goes from 2 to 1.5 percent.

The target of the European central bank is zero inflation in Europe. The instrument of the European central bank is European money supply. By equation (3), the reaction function of the European central bank is:

$$2M_1 = -2B_1 + M_2 \tag{5}$$

An increase in B_1 requires a cut in European money supply. And a cut in American money supply requires a cut in European money supply.

The target of the American central bank is zero inflation in America. The instrument of the American central bank is American money supply. By equation (4), the reaction function of the American central bank is:

$$2M_2 = -2B_2 + M_1 \tag{6}$$

An increase in B_2 requires a cut in American money supply. And a cut in European money supply requires a cut in American money supply.

2) The dynamic model. We assume that the European central bank and the American central bank decide simultaneously and independently. Step 1 refers to a specific shock. Step 2 refers to the time lag. Step 3 refers to monetary policies in Europe and America. Step 4 refers to the time lag. Step 5 refers to monetary policies in Europe and America. Step 6 refers to the time lag. And so on.

Now have a closer look at the dynamic model. Step 1 refers to a specific shock. This could be a demand shock, a supply shock or a mixed shock, in Europe or America. Step 2 refers to the time lag. This includes both the inside lag and the outside lag. In step 3, the central banks decide simultaneously and independently. The European central bank sets European money supply so as to achieve zero inflation in Europe. The reaction function of the European central bank is:

$$2M_1 = -2B_1 + M_2 \tag{7}$$

The American central bank sets American money supply so as to achieve zero inflation in America. The reaction function of the American central bank is:

$$2M_2 = -2B_2 + M_1 \tag{8}$$

Step 4 refers to the time lag. In step 5, the central banks decide simultaneously and independently. The European central bank sets European money supply so as to achieve zero inflation in Europe. The reaction function of the European central bank is:

$$2M_1 = -2B_1 + M_2 \tag{9}$$

The American central bank sets American money supply so as to achieve zero inflation in America. The reaction function of the American central bank is:

$$2M_2 = -2B_2 + M_1 \tag{10}$$

Step 6 refers to the time lag. And so on. Then what are the dynamic characteristics of this process?

2. Some Numerical Examples

It proves useful to study six distinct cases:
- a common demand shock
- a common supply shock
- a common mixed shock
- a demand shock in Europe
- a supply shock in Europe
- a mixed shock in Europe.

The target of the European central bank is zero inflation in Europe. And the target of the American central bank is zero inflation in America.

1) A common demand shock. In each of the regions, let initial unemployment be zero, and let initial inflation be zero as well. Step one refers to a decline in the demand for European and American goods. In terms of the model there is a 4

unit increase in A_1, as there is in A_2. On the other hand, there is a 4 unit decline in B_1, as there is in B_2. Step two refers to the time lag. Unemployment in Europe goes from zero to 4 percent, as does unemployment in America. On the other hand, inflation in Europe goes from zero to -4 percent, as does inflation in America.

In step three, the central banks decide simultaneously and independently. First consider monetary policy in Europe. Current inflation in Europe is -4 percent, and target inflation in Europe is zero percent. So what is needed is an increase in European money supply of 4 units. Second consider monetary policy in America. Current inflation in America is -4 percent, and target inflation in America is zero percent. So what is needed is an increase in American money supply of 4 units.

Step four refers to the time lag. The 4 unit increase in European money supply lowers European unemployment and raises European inflation by 4 percentage points each. And what is more, it raises American unemployment and lowers American inflation by 2 percentage points each. The 4 unit increase in American money supply lowers American unemployment and raises American inflation by 4 percentage points each. And what is more, it raises European unemployment and lowers European inflation by 2 percentage points each.

The total decline in European unemployment is 2 percentage points. The total increase in European inflation is 2 percentage points. The total decline in American unemployment is 2 percentage points. And the total increase in American inflation is 2 percentage points. As a consequence, unemployment in Europe goes from 4 to 2 percent, as does unemployment in America. And inflation in Europe goes from -4 to -2 percent, as does inflation in America.

In step five, the central banks decide simultaneously and independently. First consider monetary policy in Europe. Current inflation in Europe is -2 percent, and target inflation in Europe is zero percent. So what is needed is an increase in European money supply of 2 units. Second consider monetary policy in America. Current inflation in America is -2 percent, and target inflation in America is zero percent. So what is needed is an increase in American money supply of 2 units.

Step six refers to the time lag. The 2 unit increase in European money supply lowers European unemployment and raises European inflation by 2 percentage points each. And what is more, it raises American unemployment and lowers American inflation by 1 percentage point each. The 2 unit increase in American money supply lowers American unemployment and raises American inflation by 2 percentage points each. And what is more, it raises European unemployment and lowers European inflation by 1 percentage point each.

The total decline in European unemployment is 1 percentage point. The total increase in European inflation is 1 percentage point. The total decline in American unemployment is 1 percentage point. And the total increase in American inflation is 1 percentage point. As a consequence, unemployment in Europe goes from 2 to 1 percent, as does unemployment in America. And inflation in Europe goes from -2 to -1 percent, as does inflation in America.

In step seven, the central banks decide simultaneously and independently. First consider monetary policy in Europe. Current inflation in Europe is -1 percent, and target inflation in Europe is zero percent. So what is needed is an increase in European money supply of 1 unit. Second consider monetary policy in America. Current inflation in America is -1 percent, and target inflation in America is zero percent. So what is needed is an increase in American money supply of 1 unit. And so on. Table 1.1 presents a synopsis.

Now consider the long-run equilibrium. In each of the regions there is zero unemployment and zero inflation. There is no change in European or American money supply. However, taking the sum over all periods, the increase in European money supply is 8 units, as is the increase in American money supply.

As a result, given a common demand shock, monetary interaction produces both zero unemployment and zero inflation in each of the regions. There are repeated increases in money supply. There are repeated cuts in unemployment. And there are repeated cuts in deflation.

Table 1.1
Monetary Interaction
A Common Demand Shock

Europe		America	
Unemployment	4	Unemployment	4
Inflation	− 4	Inflation	− 4
Δ Money Supply	4	Δ Money Supply	4
Unemployment	2	Unemployment	2
Inflation	− 2	Inflation	− 2
Δ Money Supply	2	Δ Money Supply	2
Unemployment	1	Unemployment	1
Inflation	− 1	Inflation	− 1
Δ Money Supply	1	Δ Money Supply	1
and so on			

2) A common supply shock. In each of the regions, let initial unemployment be zero, and let initial inflation be zero as well. Step one refers to the common supply shock. In terms of the model there is a 4 unit increase in B_1, as there is in B_2. And there is a 4 unit increase in A_1, as there is in A_2. Step two refers to the time lag. Inflation in Europe goes from zero to 4 percent, as does inflation in America. And unemployment in Europe goes from zero to 4 percent, as does unemployment in America.

In step three, the central banks decide simultaneously and independently. First consider monetary policy in Europe. Current inflation in Europe is 4 percent, and target inflation in Europe is zero percent. So what is needed is a reduction in European money supply of 4 units. Second consider monetary policy in America. Current inflation in America is 4 percent, and target inflation in America is zero percent. So what is needed is a reduction in American money supply of 4 units.