CeGE-Discussion Paper

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Michael Carlberg

Monetary and Fiscal Policy Interactions in the Euro Area

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Abstract

This paper studies the interactions between monetary and fiscal policies in the euro area. The focus is on the union central bank, the German government, and the French government. The policy targets are price stability in the union, full employment in Germany, and full employment in France. The policy instruments are union money supply, German government purchases, and French government purchases. As a rule, the spillovers of fiscal policy are negative. The policy decisions are taken sequentially or simultaneously. This paper carefully discusses the case for central bank independence and fiscal cooperation between Germany and France.

Professor Michael Carlberg
Department of Economics
Federal University
Holstenhofweg 85
D-22043 Hamburg
Germany

Phone +49 40 6541 2775
Fax   +49 40 6541 2043
Email carlberg@unibw-hamburg.de

1. Introduction

This paper studies the international coordination of economic policy in a monetary union. It carefully discusses the process of policy competition and the structure of policy cooperation. The primary target of the union central bank is price stability in the union. The secondary target of the union central bank is high employment in Germany and France. The target of the German government is full employment in Germany. And the target of the French government is full employment in France. Fiscal policy in one of the countries has a large external effect on the other country. For instance, an increase in German government purchases causes a decline in French output. The key questions are: Does the process of policy competition lead to full employment and price stability? Can policy cooperation achieve full employment and price stability? And is policy cooperation superior to policy competition? The paper is organized as follows: Monetary policy in the union – Fiscal competition between Germany and France – Fiscal cooperation between Germany and France – Competition between the union central bank, the German government, and the French government – Cooperation between the union central bank, the German government, and the French government – Independent central bank, fiscal cooperation between Germany and France.

The seminal paper by Levin (1983) is a natural extension of the classic papers by Fleming and Mundell. It deals with stabilization policy in a jointly floating currency area. It turns out, however, that the joint float produces results for the individual countries within the currency area and for the area as a whole that in some cases differ sharply from those in the Fleming and Mundell papers. The most surprising finding is that a fiscal expansion by one of the countries in the currency area produces a contraction of economic activity in the other country. This beggar-my-neighbour effect can be so strong as to cause a decline in economic activity within the area as a whole. Some recent books and papers on policy coordination in a monetary union are R. Beetsma, C. Favero, A. Missale and A. Muscatelli (2003), M. Buti (2003), A. Dixit (2001), B. Eichengreen (1997), European Central Bank (2003), A. Hughes Hallet, P. Mooslechner and M. Schuerz (2001), H. Uhlig (2002), J. von Hagen and S. Mundschenk (2001).

2. Monetary Policy in the Union

1) The model. The monetary union consists of two countries, say Germany and France. The monetary union is an open economy with international trade and capital mobility. The exchange rate between the monetary union and rest of the world is flexible. There is international trade between Germany, France, and the rest of the world. Similarly, there is high capital mobility between Germany, France, and the rest of the world. German goods, French goods, and rest-of-the-world goods are imperfect substitutes for each other. German output is determined by the demand for German goods. French output is determined by the demand for French goods. And rest-of-the-world output is determined by the demand for rest-of-the-world goods. Union money demand equals union money supply. And rest-of-the-world money demand equals rest-of-the-world money supply. The union countries are the same size and have the same behavioural functions. Nominal wages and prices are slow.

As a result, an increase in union money supply raises both German output and French output, to the same extent respectively. Now have a closer look at the process of adjustment. An increase in union money supply causes a depreciation of the euro and a decline in the world interest rate. The depreciation of the euro raises both German exports and French exports. The decline in the world interest rate raises both German investment and French investment. As a consequence, German output and French output move up. This model is in the tradition of the Mundell-Fleming model, the Levin model, and many other ones, see Carlberg (2000) p. 179.

The primary target of the union central bank is price stability in the union. The secondary target of the union central bank is high employment in Germany and France. The instrument of the union central bank is union money supply. It proves useful to consider two distinct cases:
- unemployment in Germany and France
- inflation in Germany and France.

First consider unemployment in Germany and France. More precisely, let unemployment in Germany exceed unemployment in France. Then the specific target of the union central bank is full employment in France. Aiming for full employment in Germany would imply overemployment in France and, hence,

inflation in France. Second consider inflation in Germany and France. Let there be overemployment in Germany and France, and let overemployment in Germany exceed overemployment in France. Then the specific target of the union central bank is full employment in Germany and, thus, price stability in Germany. Aiming for full employment in France would imply overemployment in Germany and, hence, inflation in Germany.

2) Some numerical examples. An increase in union money supply of 100 causes an increase in German output of 150 and an increase in French output of equally 150. Further let full-employment output in Germany be 1000, and let full-employment output in France be the same.

First consider unemployment in Germany and France. More precisely, let unemployment in Germany exceed unemployment in France. Let German output be 940, and let French output be 970. That is to say, the output gap in Germany is 60, and the output gap in France is 30. In this situation, the specific target of the union central bank is to close the output gap in France. The monetary policy multiplier in France is 1.5. So what is needed is an increase in union money supply of 20. This policy action raises German output and French output by 30 each. As a consequence, German output goes from 940 to 970, and French output goes from 970 to 1000. In France there is now full employment. In Germany unemployment comes down, but there is still some unemployment left. As a result, monetary policy in the union can achieve full employment in France. Moreover, monetary policy in the union can reduce unemployment in Germany. However, monetary policy in the union cannot achieve full employment in Germany and France.

Second consider inflation in Germany and France. Let there be overemployment in Germany and France, and let overemployment in Germany exceed overemployment in France. Let German output be 1060, and let French output be 1030. That is to say, the inflationary gap in Germany is 60, and the inflationary gap in France is 30. In this situation, the specific target of the union central bank is to close the inflationary gap in Germany. The monetary policy multiplier in Germany is 1.5. So what is needed is a reduction in union money supply of 40. This policy action lowers German output and French output by 60 each. As a consequence, German output goes from 1060 to 1000, and French output goes from 1030 to 970. There is now price stability in the union. In

addition, there is full employment in Germany. As an adverse side effect, there is unemployment in France. As a result, monetary policy in the union can achieve price stability in the union. On the other hand, monetary policy in the union cannot achieve full employment in Germany and France.

3. Fiscal Competition between Germany and France

1) The static model. As a point of reference, consider the static model. As a result, an increase in German government purchases raises German output. On the other hand, it lowers French output. Here the rise in German output exceeds the fall in French output. Correspondingly, an increase in French government purchases raises French output. On the other hand, it lowers German output. Here the rise in French output exceeds the fall in German output. In the numerical example, an increase in German government purchases of 100 causes an increase in German output of 100 and a decline in French output of 50. Correspondingly, an increase in French government purchases of 100 causes an increase in French output of 100 and a decline in German output of 50. Now have a closer look at the process of adjustment. An increase in German government purchases causes an appreciation of the euro and an increase in the world interest rate. The appreciation of the euro lowers both German exports and French exports. The increase in the world interest rate lowers both German investment and French investment. The net effect is that German output moves up. However, French output moves down. This model is in the tradition of the Mundell-Fleming model, the Levin model, and many other ones, see Carlberg (2000) p. 179.

The static model can be represented by a system of two equations:

$$Y_1 = A_1 + \gamma G_1 - \delta G_2 \tag{1}$$

$$Y_2 = A_2 + \gamma G_2 - \delta G_1 \tag{2}$$

According to equation (1), German output Y_1 is determined by German government purchases G_1, French government purchases G_2, and some other factors called A_1. According to equation (2), French output Y_2 is determined by French government purchases G_2, German government purchases G_1, and some other factors called A_2. Here γ and δ denote the fiscal policy multipliers. The

internal effect of fiscal policy is positive $\gamma > 0$. By contrast, the external effect of fiscal policy is negative $\delta > 0$. In absolute values, the internal effect is larger than the external effect $\gamma > \delta$. The endogenous variables are German output and French output.

2) The dynamic model. At the beginning there is unemployment in both Germany and France. More precisely, unemployment in Germany exceeds unemployment in France. The target of the German government is full employment in Germany. The instrument of the German government is German government purchases. The German government raises German government purchases so as to close the output gap in Germany:

$$G_1 - G_1^{-1} = \frac{\overline{Y}_1 - Y_1}{\gamma} \tag{3}$$

Here is a list of the new symbols:

Y_1 German output this period
$\overline{Y}_1$ full-employment output in Germany
$\overline{Y}_1 - Y_1$ output gap in Germany this period
G_1^{-1} German government purchases last period
G_1 German government purchases this period
$G_1 - G_1^{-1}$ increase in German government purchases.
Here the endogenous variable is German government purchases this period G_1.

The target of the French government is full employment in France. The instrument of the French government is French government purchases. The French government raises French government purchases so as to close the output gap in France:

$$G_2 - G_2^{-1} = \frac{\overline{Y}_2 - Y_2}{\gamma} \tag{4}$$

Here is a list of the new symbols:

Y_2 French output this period
$\overline{Y}_2$ full-employment output in France
$\overline{Y}_2 - Y_2$ output gap in France this period
G_2^{-1} French government purchases last period

G_2 French government purchases this period

$G_2 - G_2^{-1}$ increase in French government purchases.

Here the endogenous variable is French government purchases this period G_2. We assume that the German government and the French government decide simultaneously and independently.

In addition there is an output lag. German output next period is determined by German government purchases this period as well as by French government purchases this period:

$$Y_1^{+1} = A_1 + \gamma G_1 - \delta G_2 \tag{5}$$

Here Y_1^{+1} denotes German output next period. In the same way, French output next period is determined by French government purchases this period as well as by German government purchases this period:

$$Y_2^{+1} = A_2 + \gamma G_2 - \delta G_1 \tag{6}$$

Here Y_2^{+1} denotes French output next period.

On this basis, the dynamic model can be characterized by a system of four equations:

$$G_1 - G_1^{-1} = \frac{\overline{Y}_1 - Y_1}{\gamma} \tag{7}$$

$$G_2 - G_2^{-1} = \frac{\overline{Y}_2 - Y_2}{\gamma} \tag{8}$$

$$Y_1^{+1} = A_1 + \gamma G_1 - \delta G_2 \tag{9}$$
$$Y_2^{+1} = A_2 + \gamma G_2 - \delta G_1 \tag{10}$$

Equation (7) shows the policy response in Germany, (8) shows the policy response in France, (9) shows the output lag in Germany, and (10) shows the output lag in France. The endogenous variables are German government

purchases this period G_1, French government purchases this period G_2, German output next period Y_1^{+1}, and French output next period Y_2^{+1}.

3) The steady state. In the steady state by definition we have:

$$G_1 = G_1^{-1} \tag{11}$$

$$G_2 = G_2^{-1} \tag{12}$$

Equation (11) has it that German government purchases do not change any more. Similarly, equation (12) has it that French government purchases do not change any more. Therefore the steady state can be captured by a system of four equations:

$$Y_1 = \overline{Y}_1 \tag{13}$$

$$Y_2 = \overline{Y}_2 \tag{14}$$

$$Y_1 = A_1 + \gamma G_1 - \delta G_2 \tag{15}$$

$$Y_2 = A_2 + \gamma G_2 - \delta G_1 \tag{16}$$

Here the endogenous variables are German output Y_1, French output Y_2, German government purchases G_1, and French government purchases G_2. According to equation (13) there is full employment in Germany, so German output is constant. According to equation (14) there is full employment in France, so French output is constant too. Further, equations (15) and (16) give the steady-state levels of German and French government purchases.

The model of the steady state can be compressed to a system of only two equations:

$$\overline{Y}_1 = A_1 + \gamma G_1 - \delta G_2 \tag{17}$$

$$\overline{Y}_2 = A_2 + \gamma G_2 - \delta G_1 \tag{18}$$

Here the endogenous variables are German government purchases and French government purchases. To simplify notation we introduce:

$$B_1 = \overline{Y}_1 - A_1 \tag{19}$$

$$B_2 = \overline{Y}_2 - A_2 \tag{20}$$

With this, the model of the steady state can be written as follows:

$$B_1 = \gamma G_1 - \delta G_2 \tag{21}$$

$$B_2 = \gamma G_2 - \delta G_1 \tag{22}$$

The endogenous variables are still G_1 and G_2.

Next we solve the model for the endogenous variables:

$$G_1 = \frac{\gamma B_1 + \delta B_2}{\gamma^2 - \delta^2} \tag{23}$$

$$G_2 = \frac{\gamma B_2 + \delta B_1}{\gamma^2 - \delta^2} \tag{24}$$

Equation (23) shows the steady-state level of German government purchases, and equation (24) shows the steady-state level of French government purchases. As a result, there is a steady state if and only if $\gamma \neq \delta$. Owing to the assumption $\gamma > \delta$, this condition is fulfilled.

As an alternative, the steady state can be represented in terms of the initial output gap and the total increase in government purchases. Taking differences in equations (1) and (2), the model of the steady state can be written as follows:

$$\Delta Y_1 = \gamma \Delta G_1 - \delta \Delta G_2 \tag{25}$$

$$\Delta Y_2 = \gamma \Delta G_2 - \delta \Delta G_1 \tag{26}$$

Here ΔY_1 is the initial output gap in Germany, ΔY_2 is the initial output gap in France, ΔG_1 is the total increase in German government purchases, and ΔG_2 is the total increase in French government purchases. The endogenous variables are ΔG_1 and ΔG_2. The solution to the system (25) and (26) is:

$$\Delta G_1 = \frac{\gamma \Delta Y_1 + \delta \Delta Y_2}{\gamma^2 - \delta^2} \tag{27}$$

$$\Delta G_2 = \frac{\gamma \Delta Y_2 + \delta \Delta Y_1}{\gamma^2 - \delta^2} \tag{28}$$

4) Stability. Eliminate Y_1 in equation (7) by means of equation (9) and rearrange terms $\overline{Y}_1 = A_1 + \gamma G_1 - \delta G_2^{-1}$. By analogy, eliminate Y_2 in equation (8) by means of equation (10) to arrive at $\overline{Y}_2 = A_2 + \gamma G_2 - \delta G_1^{-1}$. On this basis, the dynamic model can be described by a system of two equations:

$$\overline{Y}_1 = A_1 + \gamma G_1 - \delta G_2^{-1} \tag{29}$$

$$\overline{Y}_2 = A_2 + \gamma G_2 - \delta G_1^{-1} \tag{30}$$

Here the endogenous variables are German government purchases this period G_1 and French government purchases this period G_2. To simplify notation we make use of equations (19) and (20). With this, the dynamic model can be written as follows:

$$B_1 = \gamma G_1 - \delta G_2^{-1} \tag{31}$$

$$B_2 = \gamma G_2 - \delta G_1^{-1} \tag{32}$$

The endogenous variables are still G_1 and G_2.

Now substitute equation (32) into equation (31) and solve for:

$$\gamma G_1 = B_1 + \frac{\delta B_2}{\gamma} + \frac{\delta^2 G_1^{-2}}{\gamma} \tag{33}$$

Then differentiate equation (33) for G_1^{-2}:

$$\frac{dG_1}{dG_1^{-2}} = \frac{\delta^2}{\gamma^2} \tag{34}$$

Finally the stability condition is $\delta^2 / \gamma^2 < 1$ or:

$$\gamma > \delta \tag{35}$$

That means, the steady state is stable if and only if the internal effect of fiscal policy is larger than the external effect of fiscal policy. This condition is satisfied. As a result, there is a stable steady state of fiscal competition. In other words, fiscal competition between Germany and France leads to full employment in Germany and France.

5) A numerical example. An increase in German government purchases of 100 causes an increase in German output of 100 and a decline in French output of 50. Correspondingly, an increase in French government purchases of 100 causes an increase in French output of 100 and a decline in German output of 50. Further let full-employment output in Germany be 1000, and let full-employment output in France be the same.

Let initial output in Germany be 940, and let initial output in France be 970. Step 1 refers to the policy response. The output gap in Germany is 60. The fiscal policy multiplier in Germany is 1. So what is needed in Germany is an increase in German government purchases of 60. The output gap in France is 30. The fiscal policy multiplier in France is 1. So what is needed in France is an increase in French government purchases of 30. Step 2 refers to the output lag. The increase in German government purchases of 60 causes an increase in German output of 60. As a side effect, it causes a decline in French output of 30. The increase in French government purchases of 30 causes an increase in French output of 30. As a side effect, it causes a decline in German output of 15. The net effect is an increase in German output of 45 and an increase in French output of zero. As a consequence, German output goes from 940 to 985, while French output stays at 970.

Why does the German government not succeed in closing the output gap in Germany? The underlying reason is the negative external effect of the increase in French government purchases. And why does the French government not succeed in closing the output gap in France? The underlying reason is the negative external effect of the increase in German government purchases.

Step 3 refers to the policy response. The output gap in Germany is 15. The fiscal policy multiplier in Germany is 1. So what is needed in Germany is an increase in German government purchases of 15. The output gap in France is 30. The fiscal policy multiplier in France is 1. So what is needed in France is an increase in French government purchases of 30. Step 4 refers to the output lag. The increase in German government purchases of 15 causes an increase in German output of 15. As a side effect, it causes a decline in French output of 7.5. The increase in French government purchases of 30 causes an increase in French output of 30. As a side effect, it causes a decline in German output of 15. The net effect is an increase in German output of zero and an increase in French output of 22.5. As a consequence, German output stays at 985, while French output goes from 970 to 992.5. And so on. Table 1 presents a synopsis.

What are the dynamic characteristics of this process? There are repeated increases in German government purchases, as there are in French government purchases. There are repeated increases in German output, as there are in French output. As a result, the process of fiscal competition leads to full employment. Taking the sum over all periods, the increase in German government purchases is 100, and the increase in French government purchases is 80. The total increase in German government purchases is very large, as compared to the initial output gap in Germany of 60. And the total increase in French government purchases is even larger, as compared to the initial output gap in France of 30. The effective multiplier in Germany is $60/100 = 0.6$, and the effective multiplier in France is $30/80 = 0.38$. That is to say, the effective multiplier in Germany is very small, and the effective multiplier in France is even smaller.

4. Fiscal Cooperation between Germany and France

1) The model. At the start there is unemployment in both Germany and France. Let unemployment in Germany exceed unemployment in France. The targets of fiscal cooperation are full employment in Germany and full employment in France. The instruments of fiscal cooperation are German government purchases and French government purchases. So there are two targets and two instruments. As a result, there is a solution to fiscal cooperation. That means, fiscal cooperation between Germany and France can achieve full

employment in Germany and France. Besides, the solution to fiscal cooperation is identical to the steady state of fiscal competition.

2) A numerical example. Let initial output in Germany be 940, and let initial output in France be 970. The output gap in Germany is 60, and the output gap in France is 30. What is needed, then, is an increase in German government purchases of 100 and an increase in French government purchases of 80. The increase in German government purchases of 100 raises German output by 100 and lowers French output by 50. The increase in French government purchases of 80 raises French output by 80 and lowers German output by 40. The net effect is an increase in German output of 60 and an increase in French output of 30. As a consequence, German output goes from 940 to 1000, and French output goes from 970 to 1000. In Germany there is now full employment, and the same holds for France. As a result, fiscal cooperation can achieve full employment. However, the required increase in government purchases is very large, as compared to the initial output gap. Table 2 gives an overview.

3) Comparing fiscal cooperation with fiscal competition. Fiscal competition is a slow process. By contrast, fiscal cooperation is a fast process. Fiscal competition can cause oscillations in output. Fiscal cooperation cannot cause oscillations in output. Judging from these points of view, fiscal cooperation seems to be superior to fiscal competition.

5. Competition between the Union Central Bank, the German Government, and the French Government

1) The dynamic model. At the beginning there is unemployment in both Germany and France. More precisely, unemployment in Germany exceeds unemployment in France. The primary target of the union central bank is price stability in the union. The secondary target of the union central bank is high employment in Germany and France. The instrument of the union central bank is union money supply. The target of the German government is full employment in Germany. The instrument of the German government is German government purchases. The target of the French government is full employment in France. The instrument of the French government is French government purchases.

We assume that the central bank and the governments decide sequentially. First the central bank decides, then the governments decide. In step 1, the union central bank decides. In step 2, the German government and the French government decide simultaneously and independently. In step 3, the union central bank decides. In step 4, the German government and the French government decide simultaneously and independently. And so on. The reasons for this stepwise procedure are: First, the inside lag of monetary policy is short, whereas the inside lag of fiscal policy is long. And second, the internal effect of monetary policy is large, whereas the internal effect of fiscal policy is small. Indeed, the effective multiplier of fiscal policy is very small.

2) Some numerical examples. An increase in union money supply of 100 causes an increase in German output of 150 and an increase in French output of equally 150. An increase in German government purchases of 100 causes an increase in German output of 100 and a decline in French output of 50. Correspondingly, an increase in French government purchases of 100 causes an increase in French output of 100 and a decline in German output of 50. Further let full-employment output in Germany be 1000, and let full-employment output in France be the same. It proves useful to study two distinct cases:
  - unemployment in Germany and France
  - inflation in Germany and France.

First consider unemployment in Germany and France. Let initial output in Germany be 940, and let initial output in France be 970. Step 1 refers to monetary policy. The output gap in Germany is 60, and the output gap in France is 30. In this situation, the specific target of the union central bank is to close the output gap in France. Closing the output gap in Germany would imply overemployment in France and, hence, inflation in France. The output gap in France is 30. The monetary policy multiplier in France is 1.5. So what is needed is an increase in union money supply of 20. Step 2 refers to the output lag. The increase in union money supply of 20 causes an increase in German output of 30 and an increase in French output of equally 30. As a consequence, German output goes from 940 to 970, and French output goes from 970 to 1000.

Step 3 refers to fiscal policy. The output gap in Germany is 30. The fiscal policy multiplier in Germany is 1. So what is needed in Germany is an increase in German government purchases of 30. The output gap in France is zero. So

there is no need for a change in French government purchases. Step 4 refers to the output lag. The increase in German government purchases of 30 causes an increase in German output of 30. As a side effect, it causes a decline in French output of 15. As a consequence, German output goes from 970 to 1000, and French output goes from 1000 to 985.

Step 5 refers to monetary policy. The output gap in Germany is zero, and the output gap in France is 15. So there is no need for a change in union money supply. Step 6 refers to the output lag. As a consequence, German output stays at 1000, and French output stays at 985. Step 7 refers to fiscal policy. The output gap in Germany is zero. So there is no need for a change in German government purchases. The output gap in France is 15. The fiscal policy multiplier in France is 1. So what is needed in France is an increase in French government purchases of 15. Step 8 refers to the output lag. The increase in French government purchases of 15 causes an increase in French output of 15. As a side effect, it causes a decline in German output of 7.5. As a consequence, French output goes from 985 to 1000, and German output goes from 1000 to 992.5. And so on. For a synopsis see Table 3.

What are the dynamic characteristics of this process? There is a one-time increase in union money supply. There are repeated increases in German government purchases, as there are in French government purchases. There are damped oscillations in German output, as there are in French output. The German economy oscillates between unemployment and full employment, as does the French economy. As a result, competition between the union central bank, the German government, and the French government leads to full employment in Germany and France. Technically speaking, there is a stable steady state.

Taking the sum over all periods, the increase in German government purchases is 40, and the increase in French government purchases is 20. That means, the total increase in German government purchases is small, as compared to the initial output gap in Germany of 60. And the same applies to the total increase in French government purchases, as compared to the initial output gap in France of 30. The effective fiscal multiplier in Germany is 60/40 = 1.5, and the effective fiscal multiplier in France is 30/20 = 1.5. In other words, the effective

fiscal multiplier in Germany is large. And the same is true of the effective fiscal multiplier in France.

Second consider inflation in Germany and France. At the start there is overemployment in both Germany and France. For that reason there is inflation in both Germany and France. Let overemployment in Germany exceed overemployment in France. Let initial output in Germany be 1060, and let initial output in France be 1030. Step 1 refers to monetary policy. The inflationary gap in Germany is 60, and the inflationary gap in France is 30. In this situation, the specific target of the union central bank is to close the inflationary gap in Germany. Closing the inflationary gap in France would imply overemployment in Germany and, hence, inflation in Germany. The inflationary gap in Germany is 60. The monetary policy multiplier in Germany is 1.5. So what is needed is a reduction in union money supply of 40. Step 2 refers to the output lag. The reduction in union money supply of 40 causes a decline in German output of 60 and a decline in French output of equally 60. As a consequence, German output goes from 1060 to 1000, and French output goes from 1030 to 970.

Step 3 refers to fiscal policy. The output gap in Germany is zero. So there is no need for a change in German government purchases. The output gap in France is 30. The fiscal policy multiplier in France is 1. So what is needed in France is an increase in French government purchases of 30. Step 4 refers to the output lag. The increase in French government purchases of 30 causes an increase in French output of 30. As a side effect, it causes a decline in German output of 15. As a consequence, French output goes from 970 to 1000, and German output goes from 1000 to 985.

Step 5 refers to monetary policy. The output gap in Germany is 15, and the output gap in France is zero. So there is no need for a change in union money supply. Step 6 refers to the output lag. As a consequence, German output stays at 985, and French output stays at 1000. Step 7 refers to fiscal policy. The output gap in Germany is 15. The fiscal policy multiplier in Germany is 1. So what is needed in Germany is an increase in German government purchases of 15. The output gap in France is zero. So there is no need for a change in French government purchases. Step 8 refers to the output lag. The increase in German government purchases of 15 causes an increase in German output of 15. As a side effect, it causes a decline in French output of 7.5. As a consequence, German

output goes from 985 to 1000, and French output goes from 1000 to 992.5. And so on. For an overview see Table 4.

What are the dynamic characteristics of this process? There is a one-time reduction in union money supply. There are repeated increases in German government purchases, as there are in French government purchases. There are damped oscillations in German output, as there are in French output. The German economy oscillates between unemployment and full employment, as does the French economy. As a result, the process of monetary and fiscal competition leads to price stability and full employment. The total increase in German government purchases is 20, and the total increase in French government purchases is 40.

3) Comparing monetary and fiscal competition with pure fiscal competition. Fiscal competition is a slow process. By contrast, monetary and fiscal competition is a process of intermediate speed. Fiscal competition causes a large increase in union government purchases. Monetary and fiscal competition causes a small increase in union government purchases. Judging from these points of view, monetary and fiscal competition seems to be superior to fiscal competition.

6. Cooperation between the Union Central Bank, the German Government, and the French Government

1) Introduction. As a starting point, take the output model. It can be represented by a system of two equations:

$$Y_1 = A_1 + \alpha M + \gamma G_1 - \delta G_2 \tag{1}$$

$$Y_2 = A_2 + \alpha M + \gamma G_2 - \delta G_1 \tag{2}$$

Here Y_1 denotes German output, Y_2 is French output, M is union money supply, G_1 is German government purchases, and G_2 is French government purchases. The endogenous variables are German output and French output.

At the beginning there is unemployment in both Germany and France. More precisely, unemployment in Germany exceeds unemployment in France. The

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policy makers are the union central bank, the German government, and the French government. The targets of policy cooperation are full employment in Germany and full employment in France. The instruments of policy cooperation are union money supply, German government purchases, and French government purchases. There are two targets and three instruments, so there is one degree of freedom. As a result, there is an infinite number of solutions. In other words, cooperation between the union central bank, the German government, and the French government can achieve full employment in Germany and France.

2) The policy model. On this basis, the policy model can be characterized by a system of two equations:

$$\Delta Y_1 = \alpha \Delta M + \gamma \Delta G_1 - \delta \Delta G_2 \tag{3}$$

$$\Delta Y_2 = \alpha \Delta M + \gamma \Delta G_2 - \delta \Delta G_1 \tag{4}$$

Here ΔY_1 denotes the initial output gap in Germany, ΔY_2 is the initial output gap in France, ΔM is the required increase in union money supply, ΔG_1 is the required increase in German government purchases, and ΔG_2 is the required increase in French government purchases. The endogenous variables are ΔM, ΔG_1 and ΔG_2.

We now introduce a third target. We assume that the increase in German government purchases should be equal in size to the reduction in French government purchases $\Delta G_1 + \Delta G_2 = 0$. Put another way, we assume that the sum total of union government purchases should be constant. Add up equations (3) and (4), taking account of $\Delta G_1 + \Delta G_2 = 0$, to find out:

$$\Delta M = \frac{\Delta Y_1 + \Delta Y_2}{2\alpha} \tag{5}$$

Then subtract equation (4) from equation (3), taking account of $\Delta G_1 + \Delta G_2 = 0$, and solve for:

$$\Delta G_1 = \frac{\Delta Y_1 - \Delta Y_2}{2(\gamma + \delta)} \tag{6}$$

$$\Delta G_2 = - \frac{\Delta Y_1 - \Delta Y_2}{2(\gamma + \delta)} \tag{7}$$

Equation (5) shows the required increase in union money supply, (6) shows the required increase in German government purchases, and (7) shows the required increase in French government purchases.

3) Some numerical examples. It proves useful to study two distinct cases:
- unemployment in Germany and France
- inflation in Germany and France.

First consider unemployment in Germany and France. At the beginning there is unemployment in both Germany and France. More precisely, let unemployment in Germany exceed unemployment in France. Let initial output in Germany be 940, and let initial output in France be 970. The solution can be found in two logical steps. Step 1 refers to monetary policy. The output gap in the union is 90. The monetary policy multiplier in the union is 3. So what is needed is an increase in union money supply of 30. This policy action raises German output and French output by 45 each. As a consequence, German output goes from 940 to 985, and French output goes from 970 to 1015. In Germany there is still some unemployment left, and in France there is now some overemployment. Strictly speaking, unemployment in Germany and overemployment in France are the same size.

Step 2 refers to fiscal policy. The output gap in Germany is 15, and the output gap in France is −15. What is needed, then, is an increase in German government purchases of 10 and a reduction in French government purchases of equally 10. The increase in German government purchases of 10 raises German output by 10 and lowers French output by 5. The reduction in French government purchases of 10 lowers French output by 10 and raises German output by 5. The total effect is an increase in German output of 15 and a decline in French output of equally 15. As a consequence, German output goes from 985 to 1000, and French output goes from 1015 to 1000. In Germany there is now full employment, and the same holds for France. As a result, monetary and fiscal cooperation can achieve full employment in Germany and France. Table 5 presents a synopsis.

Second consider inflation in Germany and France. At the start there is overemployment in both Germany and France. For that reason there is inflation in both Germany and France. Let overemployment in Germany exceed overemployment in France. Let initial output in Germany be 1060, and let initial output in France be 1030. The solution can be determined in two logical steps. Step 1 refers to monetary policy. The inflationary gap in the union is 90. The monetary policy multiplier in the union is 3. So what is needed is a reduction in union money supply of 30. This policy action lowers German output and French output by 45 each. As a consequence, German output goes from 1060 to 1015, and French output goes from 1030 to 985. In Germany there is still some overemployment left, and in France there is now some unemployment. Strictly speaking, overemployment in Germany and unemployment in France are the same size.

Step 2 refers to fiscal policy. The inflationary gap in Germany is 15, and the inflationary gap in France is −15. What is needed, then, is a reduction in German government purchases of 10 and an increase in French government purchases of equally 10. The total effect is a decline in German output of 15 and an increase in French output of equally 15. As a consequence, German output goes from 1015 to 1000, and French output goes from 985 to 1000. In Germany there is now full employment and, hence, price stability. And the same applies to France. As a result, monetary and fiscal cooperation can achieve both price stability and full employment. Table 6 gives an overview.

3) Comparing monetary and fiscal cooperation with monetary and fiscal competition. Monetary and fiscal competition is a process of intermediate speed. By contrast, monetary and fiscal cooperation is a fast process. Monetary and fiscal competition causes a small increase in union government purchases. Monetary and fiscal cooperation causes a zero increase in union government purchases. Monetary and fiscal competition causes oscillations in output. Monetary and fiscal cooperation does not cause oscillations in output. Judging from these points of view, the system of monetary and fiscal cooperation seems to be superior to the system of monetary and fiscal competition.

7. Independent Central Bank, Fiscal Cooperation between Germany and France

1) The model. As a point of reference, consider the static model. It can be represented by a system of two equations:

$$Y_1 = A_1 + \alpha M + \gamma G_1 - \delta G_2 \tag{1}$$

$$Y_2 = A_2 + \alpha M + \gamma G_2 - \delta G_1 \tag{2}$$

The policy makers are the union central bank, the German government, and the French government. The primary target of the union central bank is price stability in the union. The secondary target of the union central bank is high employment in Germany and France. The instrument of the union central bank is union money supply. The targets of fiscal cooperation are full employment in Germany and full employment in France. The instruments of fiscal cooperation are German government purchases and French government purchases. With respect to fiscal cooperation there are two targets and two instruments. We assume that the central bank and the governments decide sequentially. First the union central bank decides independently. Then the German government and the French government decide cooperatively.

At the beginning there is unemployment in both Germany and France. More precisely, unemployment in Germany exceeds unemployment in France. In step 1, the union central bank decides independently. The specific target of the union central bank is full employment in the union:

$$2\alpha\Delta M = \Delta Y_1 + \Delta Y_2 \tag{3}$$

Here ΔY_1 denotes the initial output gap in Germany, ΔY_2 is the initial output gap in France, $\Delta Y_1 + \Delta Y_2$ is the initial output gap in the union, and ΔM is the required increase in union money supply.

In step 2, the German government and the French government decide cooperatively. Taking differences in equations (1) and (2), the model of fiscal cooperation can be described by a system of two equations:

$$\Delta Y_1 = \alpha\Delta M + \gamma\Delta G_1 - \delta\Delta G_2 \tag{4}$$

$$\Delta Y_2 = \alpha\Delta M + \gamma\Delta G_2 - \delta\Delta G_1 \tag{5}$$

Here ΔG_1 denotes the required increase in German government purchases, and ΔG_2 is the required increase in French government purchases. The exogenous variables are ΔY_1, ΔY_2 and ΔM. The endogenous variables are ΔG_1 and ΔG_2.

Equations (3), (4) and (5) can be solved in the following way:

$$\Delta G_1 = \frac{\Delta Y_1 - \Delta Y_2}{2(\gamma + \delta)} \tag{6}$$

$$\Delta G_2 = \frac{\Delta Y_2 - \Delta Y_1}{2(\gamma + \delta)} \tag{7}$$

As a result, the system of monetary independence and fiscal cooperation can achieve full employment in Germany and France.

2) A numerical example. Let initial output in Germany be 940, and let initial output in France be 970. In step 1, the union central bank decides independently. The specific target of the union central bank is full employment in the union. The output gap in the union is 90. The monetary policy multiplier in the union is 3. So what is needed is an increase in union money supply of 30. Step 2 refers to the output lag. The increase in union money supply of 30 causes an increase in German output of 45 and an increase in French output of equally 45. As a consequence, German output goes from 940 to 985, and French output goes from 970 to 1015. In Germany there is still some unemployment left, and in France there is now some overemployment. Strictly speaking, unemployment in Germany and overemployment in France are the same size.

In step 3, the German government and the French government decide cooperatively. The output gap in Germany is 15, and the output gap in France is -15. What is needed, then, is an increase in German government purchases of 10 and a reduction in French government purchases of equally 10. Step 4 refers to the output lag. The increase in German government purchases of 10 causes an increase in German output of 10 and a decline in French output 5. The reduction

in French government purchases of 10 causes a decline in French output of 10 and an increase in German output of 5. The total effect is an increase in German output of 15 and a decline in French output of equally 15. As a consequence, German output goes from 985 to 1000, and French output goes from 1015 to 1000. In Germany there is now full employment, and the same applies to France. What is needed is an increase in union money supply, an increase in German government purchases, and a reduction in French government purchases. The required increase in union government purchases is zero. For an overview see Table 7.

3) Comparing the system of monetary independence and fiscal cooperation with the system of monetary and fiscal cooperation. Monetary and fiscal cooperation is a fast process. Much the same applies to monetary independence and fiscal cooperation. Monetary and fiscal cooperation causes a zero increase in union government purchases. And the same holds for monetary independence and fiscal cooperation. Judging from these points of view, the system of monetary independence and fiscal cooperation seems to be equivalent to the system of monetary and fiscal cooperation. In other words, there is no need for monetary and fiscal cooperation.

8. Conclusion

1) Monetary policy in the union. The monetary union consists of two countries, say Germany and France. The primary target of the union central bank is price stability in the union, and the secondary target is high employment in Germany and France. Now let there be unemployment in the union. More precisely, let unemployment in Germany exceed unemployment in France. Then monetary policy in the union can achieve full employment in France. Moreover, it can reduce unemployment in Germany. However, it cannot achieve full employment in Germany and France. Instead, let there be overemployment and hence inflation. More precisely, let overemployment in Germany exceed overemployment in France. Then monetary policy in the union can achieve price stability in the union. But it cannot achieve full employment in Germany and France.

2) Fiscal competition between Germany and France. At the beginning there is unemployment in the union. More precisely, unemployment in Germany exceeds unemployment in France. As a result, the process of fiscal competition leads to full employment in Germany and France. There are repeated increases in German government purchases, as there are in French government purchases. There are repeated increases in German output, as there are in French output. However, the total increase in government purchases is very large, as compared to the initial output gap. The reason is the negative external effect of fiscal policy.

3) Fiscal cooperation between Germany and France. As a result, fiscal cooperation can achieve full employment in Germany and France. But the required increase in government purchases is very large. Fiscal cooperation is a fast process, as compared to fiscal competition.

4) Competition between the union central bank, the German government, and the French government. At the start there is unemployment in the union. Let unemployment in Germany exceed unemployment in France. As a result, the process of monetary and fiscal competition leads to full employment in Germany and France. There is a one-time increase in union money supply. There are repeated increases in German government purchases, as there are in French government purchases. There are damped oscillations in German output, as there are in French output. The German economy oscillates between unemployment and full employment, as does the French economy. The total increase in government purchases is small, as compared to the initial output gap. So monetary and fiscal competition seems to be superior to pure fiscal competition.

5) Cooperation between the union central bank, the German government, and the French government. As a result, monetary and fiscal cooperation can achieve full employment in Germany and France. And what is more, the required increase in union government purchases is zero. So monetary and fiscal cooperation seems to be superior to monetary and fiscal competition.

6) Independent central bank, fiscal cooperation between Germany and France. As a result, the system of monetary independence and fiscal cooperation can achieve full employment in Germany and France. And what is more, the required increase in union government purchases is zero. So the system of monetary

independence and fiscal cooperation seems to be equivalent to the system of monetary and fiscal cooperation. In other words, there is no need for monetary and fiscal cooperation.

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Table 1
Fiscal Competition between Germany and France

Unemployment in Germany and France

	Germany	France
Initial Output	940	970
Change in Government Purchases	60	30
Output	985	970
Change in Government Purchases	15	30
Output	985	992.5
and so on	…	…

Table 2
Fiscal Cooperation between Germany and France

Unemployment in Germany and France

	Germany	France
Initial Output	940	970
Change in Government Purchases	100	80
Output	1000	1000

Table 3
Competition between the Union Central Bank,
the German Government, and the French Government
Unemployment in Germany and France

	Germany	France
Initial Output	940	970
Change in Money Supply	20	
Output	970	1000
Change in Government Purchases	30	0
Output	1000	985
Change in Government Purchases	0	15
Output	992.5	1000
and so on	…	…

Table 4
Competition between the Union Central Bank,
the German Government, and the French Government
Inflation in Germany and France

	Germany	France
Initial Output	1060	1030
Change in Money Supply	− 40	
Output	1000	970
Change in Government Purchases	0	30
Output	985	1000
Change in Government Purchases	15	0
Output	1000	992.5
and so on	…	…

Table 5
Cooperation between the Union Central Bank,
the German Government, and the French Government
Unemployment in Germany and France

	Germany	France
Initial Output	940	970
Change in Money Supply	30	
Output	985	1015
Change in Government Purchases	10	− 10
Output	1000	1000

Table 6
Cooperation between the Union Central Bank,
the German Government, and the French Government
Inflation in Germany and France

	Germany	France
Initial Output	1060	1030
Change in Money Supply	− 30	
Output	1015	985
Change in Government Purchases	− 10	10
Output	1000	1000

Table 7
Independent Central Bank,
Fiscal Cooperation between Germany and France
The Central Bank Targets Full Employment in the Union

	Germany	France
Initial Output	940	970
Change in Money Supply	30	
Output	985	1015
Change in Government Purchases	10	− 10
Output	1000	1000

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