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Welfare Implications of the Design of a Currency Union in Case of Member Countries of Different Sizes

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I. Introduction

Exchange-rate regimes had been widely discussed in the past and were again a subject of debate from the end of the 1980s and the beginning of the 1990s, especially with the launch of European monetary union (EMU). In 1992 the members of the European Union signed the Maastricht Treaty, which set out the schedule for establishing EMU. In January 1998 the single European currency was introduced in 11 countries. Latest, the expected enlargement lead to a rise in the interest in this field. The establishment of a currency union brings about the abolition of national currencies, which are strong national symbols (see Buiter (1999, p. 297)); however, the loss of sovereign national policies did not occur as a result of the launch of EMU; this had already happened to some extent with the establishment of the European Monetary System (EMS). Under the EMS, Germany set its own monetary policy, and many other European countries adopted the German policy in order to remain within the EMS. By contrast, the European Central Bank should conduct the policy that is most appropriate for the currency area as a whole (see OECD (1999, p. 11)). Topics related to EMU, ie the euro area, are highly relevant not only to Europe but also to the world as a whole. The euro area is one of the largest economic regions of the world with 307.8 million inhabitants in 2002. In comparison, 288.2 million people lived in the United States. Euro-area GDP reached EUR 7.1 billion while that of the USA was EUR 9.4 billion (see ECB (2004b, p. 7)).

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** The paper represents the author's personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank.

Besides this study, there are already a large number of articles that treat the relevance of the optimum-currency-area criteria. As in this study, Aksoy, de Grauwe, and Dewachter (2002) consider different preferences in the various euro-area countries, different national monetary transmission processes and asymmetric shocks. Aksoy et al distinguish between three voting procedures: consensus rule in the Governing Council of the ECB, ECB rule with some national considerations, and a rule in which each representative takes a national view. As in this study, de Grauwe (2000) formally addresses the relevance of asymmetric shocks and differences in the monetary transmission processes. In decision-making either the member countries have the same weight or euro-wide aggregates are considered. Similarly, Gros and Hefeker (2002) question whether the supranational central bank of a monetary union should look at the euro-area aggregates or if it were better to minimise the average of national losses. Furthermore, von Hagen (2000a and 2000b) considers the relevance of the composition of the Governing Council to the decisions of the ECB. As below, Dixit (2001) addresses a central bank that commits itself to a weighted average of the most preferred policy rules of the member countries. In Gruner (1999), if the central bank considers aggregate variables of the currency area, a symmetric subgame-perfect Nash equilibrium arises. Provided the monetary decisions are taken by majority vote and the monetary decisions are taken by national central-bank presidents with national interests, two equilibria emerge. Either all wages in all countries rise by the same rate or half of the countries are high-wage countries and half of the countries are low-wage countries. Von Hagen and Süppel (1994) focus on the relationship between central-bank decisions and elections in the member countries. They find that elections should not occur in more than half of the member countries at one time; otherwise, the median voter of the central-bank council might take into account the political aspects of his own home country.

Below, great weight is put on the relevance of the design of the objective function of the supranational central bank. The model allows for a flexible weighting of the central-bank board and of the group of national central-bank presidents within the central-bank council. Besides, the consideration of the relative sizes of the member countries and so of the degree of labour mobility are issues that have been neglected in large parts of the existing literature. However, these aspects have important implications as they make the composition of the central-bank council crucial for the welfare of the member countries and of the currency area as a whole in face of shocks. Starting out from this framework, the con-

duct monetary policy is readdressed for several output-shock scenarios. This is also done for different monetary-transmission processes and different relative preferences for the output objective across the member countries.

Like quite a number of articles addressing central-bank policy, this paper is based on the approach provided by Barro and Gordon (1983). The starting point of the analysis is a quadratic social loss function with the inflation rate and the output level as its arguments.[1] According to Svensson (2000), a 'symmetric inflation target' as reflected in the loss function by the squared deviation of the inflation rate from its desirable value is important to fight both inflation and deflation.[2] Additionally, the central bank pursues an output target to moderate business cycles.[3] Like the supranational-central bank, both member countries are assumed to minimise their loss functions that are squared in the output levels and in the inflation rates at home. Minimising the loss function, the central bank has to consider the constraint given by the inflation-output trade-off, the Phillips curve (Phillips (1958) and Lucas (1976)).

This paper is organised as follows. The structure of the model is presented in Section II. Section III presents the optimal inflation-rate rules depending on the composition of the central-bank council. With different shock scenarios, Section IV. derives welfare implications considering the relevance of the composition of the central-bank council, the monetary transmission processes of the two countries, differences in the preference parameters in the loss functions across the member countries, the relative sizes of the member countries and the degree of labour mobility. Section V. concludes.

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1 In the derivations of the quadratic loss function, a second order approximation is applied to the utility function of a representative consumer (see *Rotemberg* and *Woodford* (1999), *Woodford* (2001) and *Galí* and *Monacelli* (2002)).

2 After an evaluation of its monetary policy in 2003, the ECB does not only aim to inflation rates below but also close to 2% in the medium run what implies the intention of avoiding deflation too (see *ECB* (2004a, p. 50 and 51)).

3 In an empirical work, *Clarida* and *Gertler* (1996) found the Bundesbank to pursue output targets: "... we find that the performance of the real economy also influences its [of the Bundesbank] decision making. It adopts a gradualist approach to disinflating and it does ease when the real economy weakens." *Clarida* and *Gertler* (1996, p. 47).

II. The Model

1. The Objective Functions of the Member Countries

A currency union composed of two countries that are allowed to differ in size is addressed. Since the member countries assess the currency union with respect to, first, the national welfare criteria, the objective functions of the two member countries are introduced. These loss functions include the squared deviations of inflation and of output from their national targets.[4] In the following, the targets are the same in the loss functions of the two countries and in that of the supranational central bank below. Additionally, to limit the analysis, both countries face the same inflation rate:[5]

$$L_t = \frac{1}{2}\left[\left(\pi_t^d - \pi^*\right)^2 + b\left(y_t - y^*\right)^2\right], \tag{1}$$

$$L_t^a = \frac{1}{2}\left[(1+b-d)\left(\pi_t^d - \pi^*\right)^2 + d\left(y_t^a - y^*\right)^2\right], \tag{2}$$

where L_t and L_t^a are the losses of the domestic and foreign country, π_t^d is the union-wide inflation rate (the difference of the price levels in logarithms in period t and in period $t-1$), y_t (y_t^a) is the logarithm of the domestic (foreign) output level in period t, π^* and y^* are the socially desired levels of these variables, and $b(d)$ is the domestic (foreign) weighting parameter reflecting the preference of the domestic (foreign) society for the output objective vis-à-vis the inflation objective with $b \geq 0$ and $0 \leq d \leq 1+b$.

If d equals b, both countries have the same relative output preferences. If d exceeds b, the foreign country is more concerned about output than the domestic country.[6]

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[4] *Horowitz* (1987) addresses the properties of the quadratic social loss function.

[5] There may be two major sources for different inflation rates. On the one hand, national monetary-demand shocks cause discrepancies in inflation rates (see *von Hagen* (2000b, p. 225 and 226)). On the other hand, different national inflation rates are possible if the degree of economic development differs across countries. Provided the international productivity differentials are greater in the production of traded goods vis-à-vis those in the production of non-traded goods, inflation differentials are found across the countries (see *Balassa* (1964)).

[6] Since the conduct of monetary policy and the assessment of the monetary regimes are based on the national loss functions, it is necessary to impose restrictions on the loss functions to avoid biased results in favour of one country. Therefore, the sum of the weights to the output and inflation objectives equals $1+b$ for

2. *The Objective Function of the Supranational Central Bank*

It is assumed that the central-bank council consists of a central-bank board and a group of national central-bank presidents. The loss function of the supranational central bank is the weighted sum of those of the board and of the group of presidents; the importance of the board vis-à-vis the national presidents is reflected by the parameter k:

$$L_t^{cb} = kL_t^{board} + (1-k)L_t^{pres}, \tag{3}$$

where k is the weight of the loss suffered by the central-bank board, L_t^{board}, and $(1-k)$ that of the losses of the national central-bank presidents, L_t^{pres}, with $k \in [0;1]$.

The members of the central-bank board are assumed to observe the economic conditions of the currency area as a whole. In doing so, they address the weighted sum of the losses that occur in the member countries:[7]

$$L_t^{board} = \frac{1}{2}\left[n\left[b_\pi^{cb}\left(\pi_t^d - \pi^*\right)^2 + b_y^{cb}\left(y_t - y^*\right)^2\right] + (1-n)\left[b_\pi^{cb}\left(\pi_t^d - \pi^*\right)^2 + b_y^{cb}\left(y_t^a - y^*\right)^2\right]\right] \tag{4}$$

with

$$b_\pi^{cb} = n + (1-n)(1+b-d) \quad \text{and} \quad b_y^{cb} = nb + (1-n)d,$$

and where $b_\pi^{cb}$and b_y^{cb} are the weights the central bank attaches to the inflation and to the output objectives. $n \in (0;1)$ is the size of the home country relative to the size of both countries together and $(1-n)$ is the relative size of the foreign country.

The weight of the data on a country in the central-bank board corresponds to the relative economic size of the country, n, as the establishment of a currency union is a decision taken for a long time horizon.

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each country. Thus, an increase in the parameter d not only stands for an increase in the foreign weight to the output objective but also for a decrease in the weight to inflation.

[7] Besides, the board may consider a loss function including the aggregate values of inflation and output of the currency area. As this design makes the central bank suffer no loss as long as the aggregates are in equilibrium though there may be national disequilibria in the currency, it is not chosen here. In contrast, the objective function above may serve as a welfare measure of the currency area as a whole. Provided the national monetary transmission processes coincide, one single monetary policy rule applies for both central-bank board objective functions.

Most probably, countries like to join a monetary union only if their weights are at least as high as their relative sizes in the union.[8]

The national central-bank presidents are interested only in their home economies and try to minimise the deviations of the national economic variables from their targets. They have equal weight in the decision-taking regardless of the relative sizes of the countries they represent:

$$L_t^{pres} = \tfrac{1}{2}L_t + \tfrac{1}{2}L_t^a \,. \tag{5}$$

3. *The Monetary Transmission Processes in the Member Countries*

The transmission of monetary policy to the real economy is described by the Phillips-curve relationship. In the two countries the Lucas-type supply functions are given by[9]

$$y_t = \alpha\left(\pi_t^d - \pi_t^{de}\right) + \varepsilon_t \,, \tag{6}$$

$$y_t^a = \alpha^a\left(\pi_t^d - \pi_t^{de}\right) + \varepsilon_t^a \,, \tag{7}$$

with

$$\alpha^a = c\alpha \,, \tag{8}$$

where π_t^{de} is the union-wide inflation rate that is expected in period $t-1$ for period t, and $\varepsilon_t(\varepsilon_t^a)$ is the effect of an iid supply shock with mean 0 and variance $\sigma^2((\sigma^a)^2)$ at home (abroad). α and α^a are the domestic and foreign sacrifice ratios of variations in surprise inflation to variations in output. $c > 0$ reflects potential differences in the monetary transmission processes between the domestic and foreign country.

Output-inflation trade-offs may differ in the two countries; this is reflected by a value of c that is different from 1. $0 < c < 1$ ($c > 1$) means

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[8] The weight in *Dornbusch, Favero* and *Giavazzi* (1998) corresponds to the ratio of its GDP to euro-area GDP. *Dixit's* (2001, p. 603)) country weights are chosen according to relative economic sizes and political powers.

[9] Here, output persistence is not considered. Output persistence would require the addition of the lagged output level on the right of equations (6) and (7) (see *Lockwood, Miller* and *Zhang* (1998)).

that monetary policy abroad is less effective (more effective) than at home.[10]

As in Svensson (1997), the natural output levels in the two countries are the unconditional means of the output levels, $E(y_t)$ and $E(y_t^a)$. These are set equal to zero.

The market participants have rational expectations:

$$\pi_t^{de} = E_{t-1}\pi_t^d , \tag{9}$$

where E_{t-1} is the expectations operator conditional on information available in period $t-1$.

4. *Labour Mobility*

In the field of exchange-rate regimes Mundell's (1961) paper on optimum currency areas has already addressed the relevance of labour mobility.

To deduce the implications of labour mobility for the economies and the national welfare levels it is necessary to explain how the labour market is related to the goods market. It is assumed that long-term output supply is accompanied by full employment. Consequently, negative output-supply shocks cause unemployment while positive supply shocks result in excess-labour demand. Migration relieves the labour market of the country in which a negative output shock occurs. Of course, if the effect of migration is positive for the country in which the negative supply shock occurs, there is a transfer of negative effects to the neighbouring country that has previously not suffered from output shocks. If there was full employment in the other country before, then the inflow of migrants would create unemployment provided wages were rigid.[11]

It is assumed below that the degree of labour mobility is the same in both countries. In the event of labour mobility the effects of the supply

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10 *Dornbusch, Favero* and *Giavazzi* (1998) attribute differences in the inflation-output trade-offs between the euro-area countries to differences in wage bargaining, in particular.

11 The issue that migration can ameliorate the situation in one country while the other country is negatively affected is captured in the simulation model of *Beine* and *Docquier* (1998, p. 241 f.).

shocks that the countries face after the completion of the migration process are the relocated effects of the initially national shocks:[12]

$$\varepsilon_t = (un + (1-u))\varepsilon_t' + u(1-n)\varepsilon_t^{a\prime}, \tag{10}$$

$$\varepsilon_t^a = (u(1-n) + (1-u))\varepsilon_t^{a\prime} + un\varepsilon_t', \tag{11}$$

where ε_t (ε_t^a) is the effect of supply shocks at home (abroad) after migration has finished, ε_t' ($\varepsilon_t^{a\prime}$) is the supply shock that initially occurs at home (abroad), and $u \in [0;1]$ is the degree of labour mobility: $u = 0$ stands for no labour mobility and $u = 1$ means perfect labour mobility.

In equations (10) and (11) the parameter u reflects the degree of labour mobility. In the case of perfect labour mobility ($u = 1$) the negative effects of the shocks that initially occur in one country are relocated in proportion to the relative country sizes to both countries. When there is no labour mobility ($u = 0$), then the countries are solely confronted with the shocks that arise at home. The shock terms of the two equations above enter equations (6) and (7).

III. Monetary Policy Dependent on the Composition of the Central Bank Council

Here, only the scenario of central-bank commitment to an optimal policy rule is considered, and as the central bank takes the formation of expectations by the private sector into account, no inflation bias arises. Thus, the expected loss is minimised with respect to the actual and expected inflation rates:[13]

$$\min_{\pi_t^d, \pi_t^{de}} E\left(L_t^{cb}\right), \tag{12}$$

subject to equations (1), (2), (3), (4), (5), (6), (7) and (9).

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12 The presentation is similar to that of *Bayoumi* (1994). However, Bayoumi does not consider the relative sizes of the countries. In *Bayoumi,* the immigration of labour increases the output level in the region with excess demand for labour but labour-force emigration does not affect the output level in the country that faces unemployment. Since, in his analysis, welfare depends on consumption, immigration increases the welfare of the first country but the welfare of the second country is unchanged by the emigration of parts of the labour force.

13 The group of central-bank presidents takes decisions by the minimisation of the sum of the loss functions of the member countries. Thus, the decisions can be interpreted as the results of Nash bargaining games or votes taken under unanimity rule (see *von Hagen* (2000b, p. 222)).

The first-order conditions are

$$
\begin{aligned}
&\big(kb_{\pi}^{cb} + (1-k)0.5\big(1 + (1+b-d)\big)\big)\big(\pi_t^d - \pi^*\big) \\
&+ k\Big[nb_y^{cb}\alpha\big(y_t - y^*\big) + (1-n)b_y^{cb}\alpha^a\big(y_t^a - y^*\big)\Big] \\
&+ (1-k)0.5\big[b\alpha\big(y_t - y^*\big) + d\alpha^a\big(y_t^a - y^*\big)\big] + \theta_{t-1} = 0\,,
\end{aligned} \tag{13}
$$

$$
\begin{aligned}
&- kE_{t-1}\Big[nb_y^{cb}\alpha\big(y_t - y^*\big) + (1-n)b_y^{cb}\alpha^a\big(y_t^a - y^*\big)\Big] \\
&- (1-k)0.5E_{t-1}\big[b\alpha\big(y_t - y^*\big) + d\alpha^a\big(y_t^a - y^*\big)\big] - \theta_{t-1} = 0\,,
\end{aligned} \tag{14}
$$

where θ_{t-1} is the Lagrange multiplier for the constraint $\pi_t^{de} = E_{t-1}\pi_t^d$.

By inserting equation (13) into equation (14), we obtain:

$$
\begin{aligned}
&\big(kb_{\pi}^{cb} + (1-k)0.5\big(1 + (1+b-d)\big)\big)\big(\pi_t^d - \pi^*\big) \\
&+ k\Big[nb_y^{cb}\alpha\big(y_t - y^*\big) + (1-n)b_y^{cb}\alpha^a\big(y_t^a - y^*\big)\Big] \\
&+ (1-k)0.5\big(b\alpha\big(y_t - y^*\big) + d\alpha^a\big(y_t^a - y^*\big)\big) \\
&- kE_{t-1}\Big[nb_y^{cb}\alpha\big(y_t - y^*\big) + (1-n)b_y^{cb}\alpha^a\big(y_t^a - y^*\big)\Big] \\
&- (1-k)0.5E_{t-1}\big[b\alpha\big(y_t - y^*\big) + d\alpha^a\big(y_t^a - y^*\big)\big] = 0\,.
\end{aligned} \tag{15}
$$

Equations (6), (7) and (15) imply that the expected inflation rate equals the socially desirable inflation target:

$$
\pi_t^{de} = \pi^*. \tag{16}
$$

With equations (6), (7), (15) and (16) the optimal inflation rule is

$$
\pi_t^d = \pi^* - \frac{knb_y^{cb}\alpha + (1-k)0.5b\alpha}{f^k}\varepsilon_t - \frac{k(1-n)b_y^{cb}\alpha^a + (1-k)0.5d\alpha^a}{f^k}\varepsilon_t^a\,, \tag{17}
$$

with

$$
\begin{aligned}
f^k &= kb_{\pi}^{cb} + (1-k)0.5(1 + (1+b-d)) \\
&\quad + kb_y^{cb}(n\alpha^2 + (1-n)(\alpha^a)^2) + (1-k)0.5(b\alpha^2 + d(\alpha^a)^2)\,.
\end{aligned}
$$

Provided $\alpha = \alpha^a$ and $b = d = b^{cb}$, equation (17) can be simplified:

$$
\pi_t^d = \pi^* - b\alpha\frac{kn + (1-k)0.5}{1 + b\alpha^2}\varepsilon_t - b\alpha\frac{k(1-n) + (1-k)0.5}{1 + b\alpha^2}\varepsilon_t^a\,. \tag{18}
$$

For $k = 1$, the central-bank board takes the monetary decisions and its stabilisation efforts with respect to the national economies depend on the relative country sizes. However, if the group of national presidents is responsible for monetary policy, $k = 0$, the relative sizes of the member countries no longer matter for the extent of stabilisation policy.

IV. Welfare Analyses for Different Shock Scenarios

1. Introduction

Here, the losses are caused by output-supply shocks at home and abroad, which lead to deviations of the output level and of the inflation rate from their desirable targets; by contrast, no losses occur, and the welfare is at a maximum in the absence of shocks as we consider the case of central-bank commitment to an optimal policy rule. The expected loss depends on the future behaviour of the shocks. For convenience, the central bank expects the behaviour of shocks to be the same for all future periods. This allows a restriction of the analysis to the loss that is expected for period t in period $t-1$. Because the central bank conducts stabilisation policy, any assessment of the design of a currency union must include consideration of the expected indirect loss, which implies central-bank policy actions. This means that the optimal inflation-rate rule, which is linear in the random variables, is plugged into the expected loss function, and the expected indirect loss is a linear function of the variances of the output shocks at home and abroad.

The welfare considerations rely on the derivatives of the expected indirect loss function with respect to the variance terms.[14]

The analytical results are given where their level of complexity allows presentation and interpretation. Otherwise, the presentation is limited to three-dimensional graphs. The visualisation of the results in graphs requires the fixing of parameter values. Thus $b = 0.5$ and $\alpha = 3$. $b = 0.5$ means that the central bank at home attributes half the weight of the inflation objective to the output objective.[15] $\alpha = 3$ expresses the assumed

[14] As the expected indirect loss is linear in the variances of the shocks, the effects of changes in the variances on the expected loss no longer depends on the variances.

[15] These values for the output-preference parameters are also chosen by *Aksoy, de Grauwe* and *Dewachter* (2002) in their euro-area simulation model. *Broadbent* and *Barro* (1997) found this to be one-third in the USA from 1954 to 1994.

inflation-output trade-off in the home country; a 1% increase in domestic surprise inflation makes the domestic output level increase by 3%.[16] In the initial sections below it is assumed that the preference parameters of the member countries are the same ($b = d = b_y^{cb}$) and, additionally, that the national monetary transmission processes do not differ ($\alpha = \alpha^a = \alpha^d$). These assumptions are relaxed in Sections 4.3 and 4.4. In the figures below, the change in the expected loss due to output shocks is displayed on the vertical axis: the higher the value is the more loss occurs.

2. *Welfare Implications of the Design of the Objective Function of the Central Bank*

In what follows, monetary policy is conducted by a central-bank council that may be composed of a central-bank board and a group of national presidents. Two output-shock scenarios are analysed: output shocks at home and negatively correlated output shocks. The welfare implications are derived for no labour mobility and labour mobility.

a) Output Shocks in the Home Country

aa) Variations in the Expected Loss of the Central Bank Without Labour Mobility

These variations are presented by equations (19) and (20) and by Figure 1.

$$(19) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{u=0} = -0.5\,\frac{bk(b\alpha^2k(2n-1)-1)}{1+b\alpha^2} \lesseqgtr 0\,,$$

$$(20) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{u=0} = -0.25b\,\frac{(b\alpha^2k(2n-1)-1)(2n-1)}{1+b\alpha^2} \leq 0.$$

[16] Beginning in 1946, *Barro* (1978) finds for the USA that a 1% increase in monetary growth leads to a 3% increase in the output level and a 1 percentage point reduction in the unemployment rate. The effects are concentrated in the first two years after the innovation.

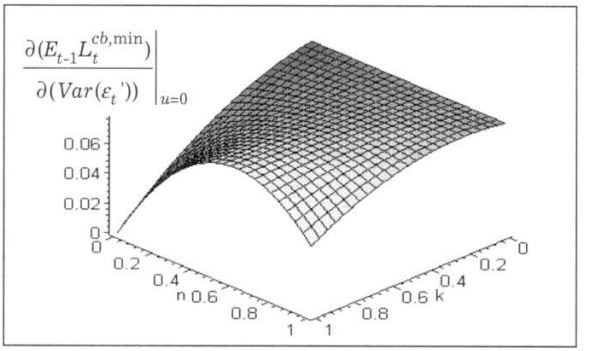


Figure 1

If the central-bank council is composed of only national central-bank presidents, $k = 0$, the expected loss of the central bank is highest which, as is indicated on the vertical axis, amounts to around 0.6. Since each national president has the same voting power in the monetary-policy-decision process, differences in the relative sizes of the member countries are not reflected in the monetary-stabilisation policy of the group of national presidents. Provided the two countries have the same size, the objective function of the board equals that of the group of national presidents, and the board and the group of national presidents take the same monetary-policy decisions. If the countries differ in size, however, the board considers the relative economic importance of the member countries with respect to the currency area as a whole, and the expected loss of the board and, with it, that of the central-bank council are reduced. Provided the home country is the small country, the expected loss of the board, $k = 1$, is low as a result of the low relevance of the home country and its output shock. If the home country is larger than the foreign country, the lower expected loss of the central-bank board can be put down to the greater efforts of the central-bank board to stabilise the economy of the large and important home country. Then, the board attributes low weight to the simultaneous destabilisation of the foreign economy.

bb) Variations in the Expected Loss of the Home Country Without Labour Mobility

Since the national president of the small country has the same weight in the central-bank council as the president of the large country, the

concerns of the small country are overrepresented in the decisions of the group of national presidents compared with those of the board. This is not the case in the central-bank board. Thus, the small country favours central-bank policy conducted by the group of national presidents. The preference of the large country is the opposite. This issue is illustrated by Figure 2, which presents the expected loss of the home country:

$$(21) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{cb,\,u=0} = -0.5b^2\alpha^2\,\frac{k(1+k-2kn)}{1+b\alpha^2} \leq 0\,,$$

$$(22) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{cb,\,u=0} = 0.25b^2\alpha^2\,\frac{(2n-1)(1+k-2kn)}{1+b\alpha^2} \leq\geq 0.$$

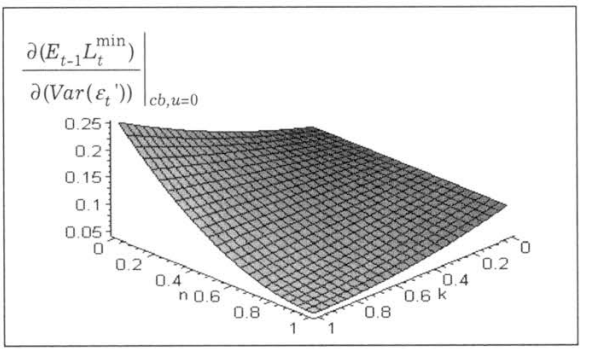


Figure 2

cc) Variations in the Expected Losses of the Central Bank and of the Home Country with Labour Mobility

Here, again, the relative size of the country hit by shocks plays a part since it reflects how relevant the shocks affect the currency area as a whole (see equation (23) and Figure 3). Under perfect labour mobility, the effects of the shocks are redistributed among the member countries in proportion to their relative size and, after the end of the migration process, the economies are affected in the same way. As a result, the monetary policy proposed by the board equals that of the group of national presidents, and so the policy no longer depends on the composition of the central-bank council.

Under perfect labour mobility, the expected loss of the central bank equals that of the home country:

$$(23) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{u=1} = \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{cb,\,u=1} = \frac{bn}{1+b\alpha^2} > 0\,,$$

$$(24) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{u=1} = \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{cb,\,u=1} = 0.$$

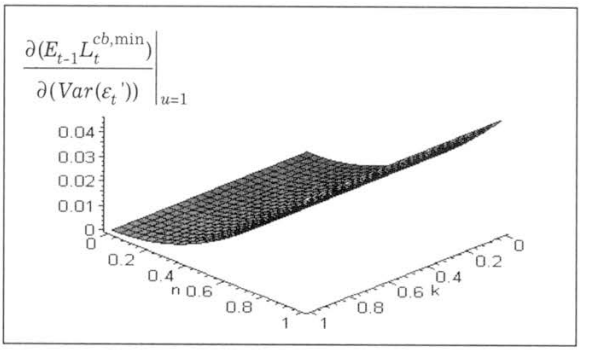


Figure 3

b) Negatively Correlated Output Shocks in the Member Countries

aa) Variations in the Expected Loss of the Central Bank Without Labour Mobility

Figure 4 shows that the expected loss of the central-bank council is greatest where both countries have the same size or where national presidents take the monetary decisions. Since the output shocks affect both countries in different ways, the national presidents propose contrasting monetary-policy measures and, as a result, the group of national presidents conducts no monetary policy at all. The central-bank board always acts unless the countries are of the same size. Then, since the stabilisation of the economy of one country is accompanied by a further destabilisation of the other and since the concerns of the two countries play the same role in the monetary decision-making process, the optimum course for the central-bank board and for the group of national central-bank presidents is to conduct no stabilisation policy. If the two countries

differ in size, the central-bank board concentrates on the concerns of the larger country. In this way the loss of the central-bank board can be reduced.

$$(25) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{\varepsilon_t^{a\prime}=-\varepsilon_t',\, u=0} = \frac{2b^2\alpha^2k^2(1-2n)}{1+b\alpha^2} \lesseqgtr 0\,,$$

$$(26) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{\varepsilon_t^{a\prime}=-\varepsilon_t',\, u=0} = -\frac{b^2\alpha^2k(1-4n(n-1))}{1+b\alpha^2} \leq 0.$$

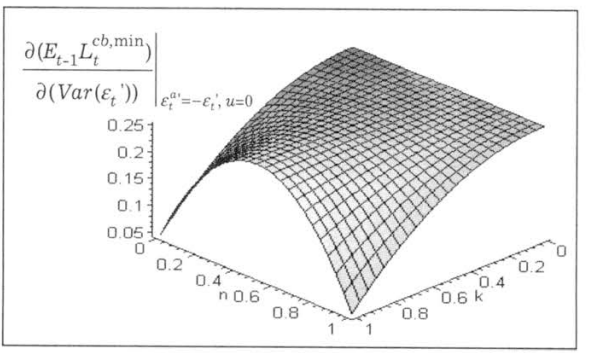


Figure 4

bb) Variations in the Expected Loss of the Home Country Without Labour Mobility

However, Figure 5 shows that, under negatively correlated output shocks, as in cases where output shocks occur solely in one member country, the expected loss of a small member country is smaller the greater the weight of the group of national central-bank presidents in the decision-making process. If the monetary decisions are taken by the board, the maximum loss of a small country is larger than in the case of output shocks limited to one country since the small country is not only negatively affected by the effects of the shocks at home but also by central-bank policy that focuses on the contrasting stabilisation interests of the large neighbouring country (see equations (27) and (28) and Figure 5).

$$(27) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{cb,\varepsilon_t^{a\prime}=-\varepsilon_t',\,u=0} = -\frac{b^2\alpha^2 k(1+k-2kn)}{1+b\alpha^2} \leq 0\,,$$

$$(28) \qquad \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{cb,\varepsilon_t^{a\prime}=-\varepsilon_t',\,u=0} = \frac{b^2\alpha^2(1-2n)(1+k-2kn)}{1+b\alpha^2} \lesseqgtr 0.$$

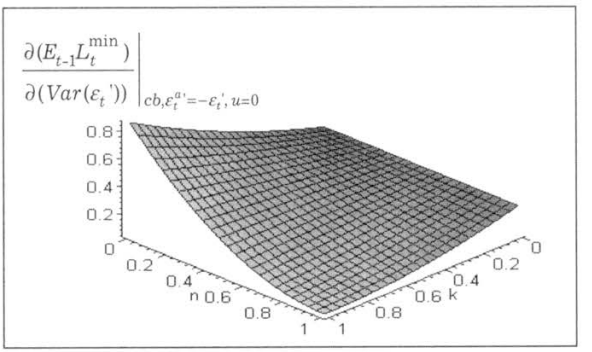


Figure 5

cc) Variations in the Expected Losses of the Central Bank and of the Home Country with Labour Mobility

Under labour mobility, as in the scenarios characterised by the incidence of shocks in one of the member countries, it does not matter if the central-bank board or the national presidents take the monetary policy decisions. Both groups in the central-bank council have the same interests and would like to conduct the same monetary policies. If the two countries differ in size, the effects of the shock originating in the larger country also dominate the economic conditions in the smaller country. This means, for example, that, if there is a negative output shock in the large country while the small country is hit by a positive output shock, migration not only provides the workers needed by the small country to stabilise its economy but also that labour forces immigrate into the small country as long as the unemployment rates differ between the two countries. Under labour mobility, again, the figures of the expected losses of the central-bank council and of the home member country coincide (see Figure 6):

$$(29)\quad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{\varepsilon_t^{a\prime}=-\varepsilon_t',\,u=1} = \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial n\Big|_{cb,\varepsilon_t^{a\prime}=-\varepsilon_t',\,u=1} = -\frac{2b(1-2n)}{1+b\alpha^2} \lesseqgtr 0\,,$$

$$(30)\quad \partial\left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{\varepsilon_t^{a\prime}=-\varepsilon_t',\,u=1} = \partial\left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(Var(\varepsilon_t'))}\right)\Big/\partial k\Big|_{cb,\varepsilon_t^{a\prime}=-\varepsilon_t',\,u=1} = 0.$$

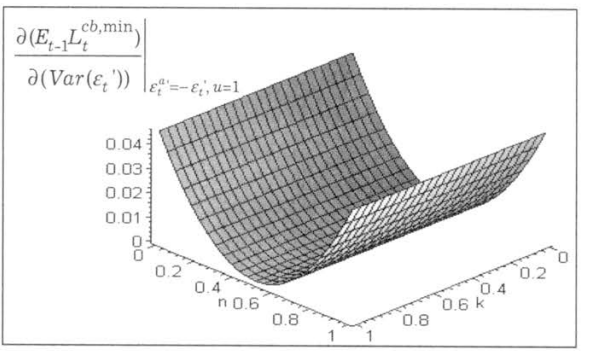


Figure 6

3. *Welfare Implications of Different Monetary Transmission Processes in the Member Countries*

Up to now, both countries have been characterised by equal monetary transmission processes. However, as introduced in Section 2.3, in the two member countries of the currency union, the impact of monetary policy on the output levels may be different. If, in equation (8), c is greater (less) than one, the monetary transmission coefficient is larger (smaller) abroad than that at home, ie $\alpha < (>)\alpha^a$, and monetary policy abroad is more (less) efficient than at home.[17]

Since, in this section, the monetary transmission coefficient is allowed to change and since we continue to present the results in three-dimensional graphs, one parameter that has been free until now has to be fixed. Thus, consideration of the composition of the central-bank council

[17] Here, the parameter c is restricted to the interval $c \in [0.5; 2]$.

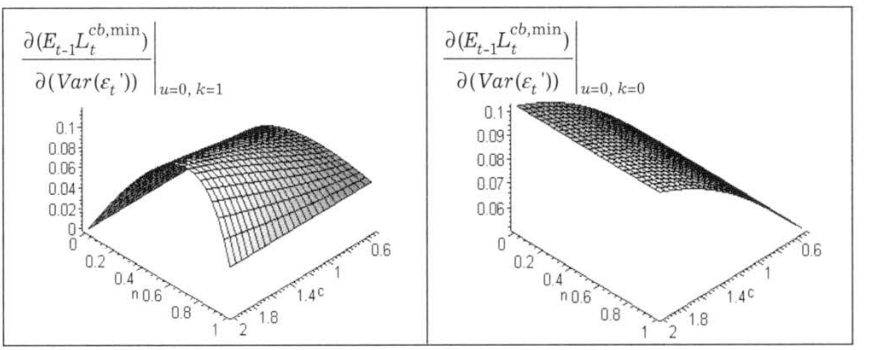
is limited to the two extremes in the following: a central-bank council that consists entirely of a central-bank board and a central-bank council that is formed entirely of national central-bank presidents.

Owing to the complexity of the analytical results, only the graphical presentation of the results is provided.

Output Shocks in the Home Country

a) Variations in the Expected Loss of the Central Bank Without Labour Mobility

Figure 7 shows the expected loss of the central-bank board if the monetary decisions are taken by the board itself. In Figure 8, by contrast, the expected loss of the group of national presidents is presented for the case where monetary policy is determined solely by the group of national presidents.

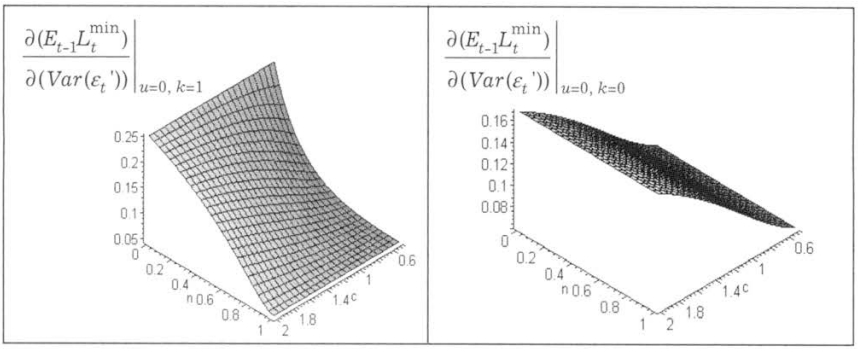


Figures 7 and 8

We see that the expected losses of the two types of central-bank council increase in the inflation-output trade-off parameter abroad, c. The stabilisation of the domestic economy, which is hit by output shocks, is at the expense of some destabilisation of the foreign economy. The higher the trade-off parameter abroad, the more costly is stabilisation of the home economy. In the end an increase in c is accompanied by less central-bank stabilisation policy and a greater expected loss by the central bank.

b) Variations in the Expected Loss of the Home Country Without Labour Mobility

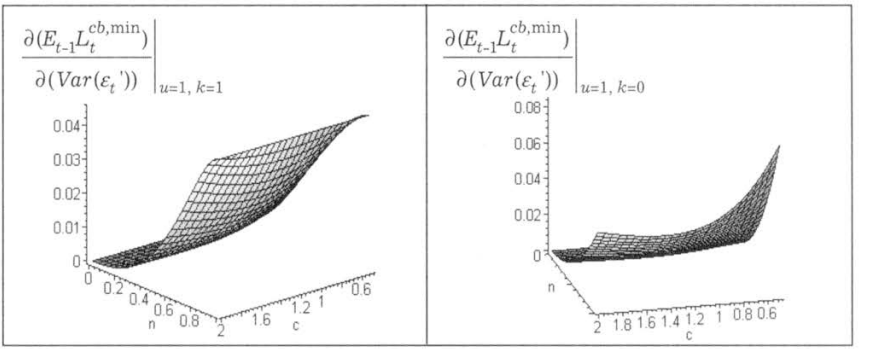
In Figures 9 and 10 it can be seen that the expected loss of the home country increases in the foreign inflation-output trade-off parameter. Then, the central bank reduces its efforts to stabilise the domestic economy since the cost of this policy, the destabilisation of the foreign country, increases. In the event of central-bank decisions taken by a central-bank board (Figure 9), the greater the stabilisation efforts made, the larger the home country.



Figures 9 and 10

c) Variations in the Expected Loss of the Central Bank with Labour Mobility

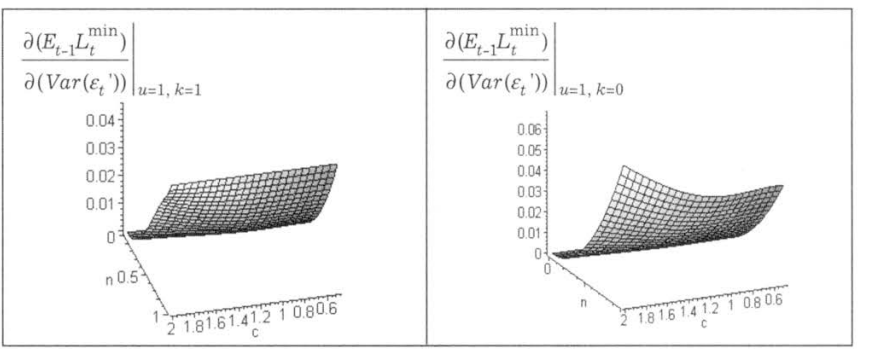
Both types of central-bank council conduct stabilisation policy at low cost if the member countries of the currency union have high and similar inflation-output trade-off parameters. The central-bank board and the group of national central-bank presidents suffer their smallest losses if the monetary transmission coefficient abroad is higher than at home – c little higher than one. Then, in relation to the currency area as a whole, monetary policies become more effective than in case of equal transmission processes, $c = 1$, and the expected losses of both types of central-bank council decrease although somewhat less stabilisation policy is conducted than is preferred by the country with the lower monetary transmission coefficient (see Figures 11 and 12).



Figures 11 and 12

d) Variations in the Expected Loss of the Home Country with Labour Mobility

In contrast to the different types of central-bank council, the home country enjoys maximum welfare provided the neighbouring country has a similar transmission coefficient. This is valid both in the case of a central-bank council composed of a central-bank board and in the case of monetary policy decisions taken by the group of national presidents (see Figures 13 and 14). Then, the conduct of monetary policy is optimal with respect to the home country.



Figures 13 and 14

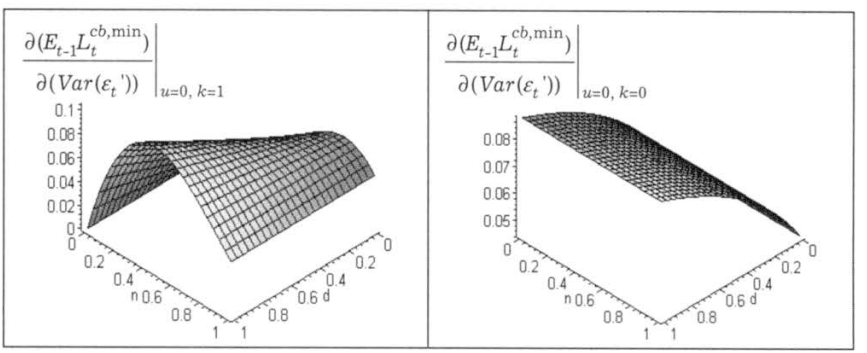
4. *Welfare Implications of Different Output Preferences in the Member Countries*

In this section we investigate differences in the output and inflation preferences of the member countries of a currency union. In its loss function, the foreign country may attach more or less weight to the output objective than the home country, $b < d$ or $b > d$ in equations (1) and (2). These national differences affect the decisions of the supranational central-bank council since the national loss functions are fundamental to the central-bank objective function. The preference parameters in the loss function of the central-bank board are the country-size-weighted sums of the preference parameters of the two member countries. Besides this, the national central-bank presidents consider the loss functions of their home countries, which include the national preference parameters. As in the section above, output shocks at home are investigated, and monetary decisions are taken either by the central-bank board or by the group of national central-bank presidents.

Output shocks in the home country

a) Variations in the Expected Loss of the Central Bank Without Labour Mobility

The expected losses of the central-bank board (see Figure 15) and of the group of national presidents (see Figure 16) are greater the higher the foreign preference for the output objective. This issue is especially relevant to the central-bank board if the foreign country is relatively large, which means that n is relatively small.

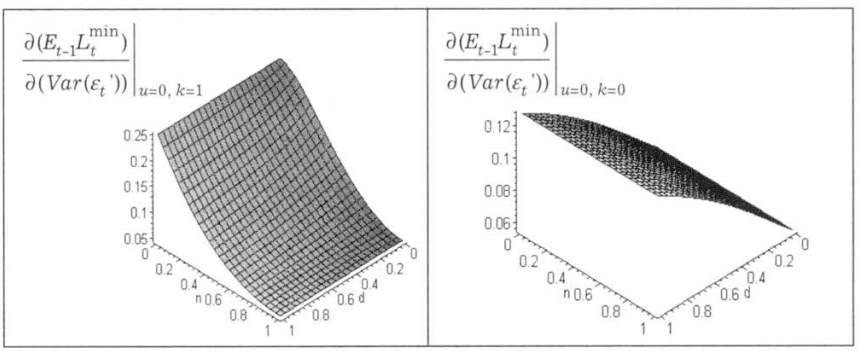


Figures 15 and 16

The conduct of stabilisation policy with respect to the domestic economy hit by shocks is at the expense of some destabilisation of the foreign economy. Although an increase in the foreign output-preference parameter is accompanied by a decrease in the inflation preference abroad, the shift in the weighting of the preference parameters results in a larger expected loss in the foreign country and, consequently, in a larger expected loss by the central bank.

b) Variations in the Expected Loss of the Home Country Without Labour Mobility

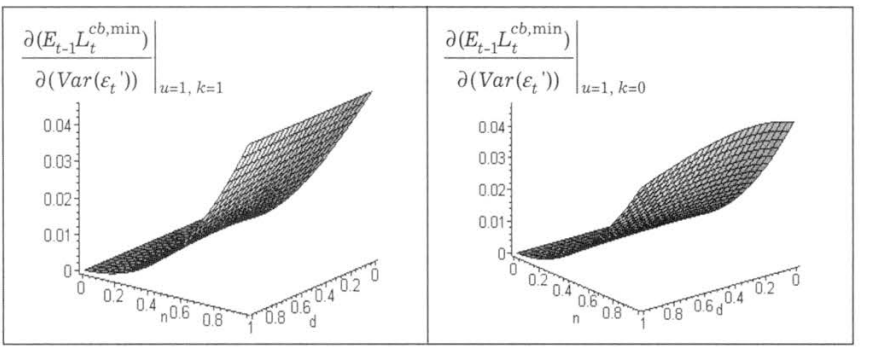
If the central-bank board takes monetary decisions (see Figure 17), the expected domestic loss is smaller the higher the output preference abroad. This outcome does not come as a surprise since, in the case of a higher output preference abroad, the output preference of the central-bank board, which is the relative size-weighted sum of the output-preference parameters of the member countries, is also higher. Thus, the board increases its efforts to stabilise the domestic economy hit by output shocks even though the deviations from the targets abroad increase. The result differs if the group of national presidents takes the monetary decisions (see Figure 18). Here, the higher output preference of the foreign central-bank president results in a larger expected loss in the home country. The higher the output preference abroad, the larger the expected loss of the foreign country due to some destabilisation of its economy, and therefore the group of national presidents decides to conduct less stabilisation policy with respect to the domestic economy.



Figures 17 and 18

c) Variations in the Expected Loss of the Central Bank with Labour Mobility

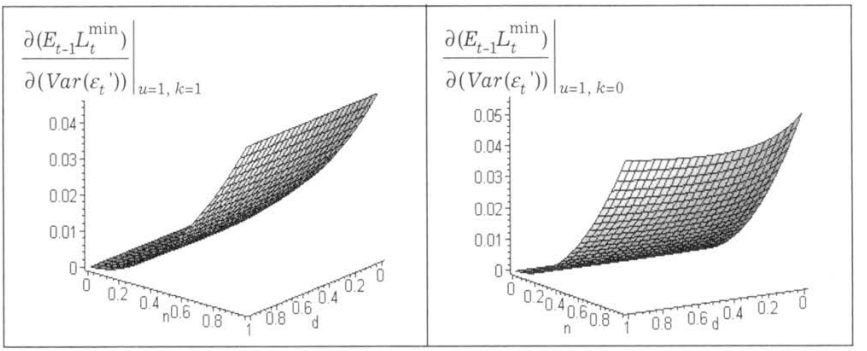
Under labour mobility, the foreign country is also directly affected by the shocks originating at home. In this case, both the expected loss of the board and the expected loss of the group of national presidents first increase before they decrease in a higher output preference of the foreign country (see Figures 19 and 20). First, an increase in the output preference abroad is accompanied by higher losses as this makes the board and the foreign central-bank president suffer more from deviations from the output targets. Afterwards, a further increase in d leads to a decrease in the expected losses of the two types of central-bank council owing to the greater stabilisation efforts of the central bank with respect to both economies while the further increase in the losses caused by larger deviations from the inflation target is relatively moderate.



Figures 19 and 20

d) Variations in the Expected Loss of the Home Country with Labour Mobility

In Figures 21 and 22 below we can see that, with both the decisions of a central-bank board and of a group of national central-bank presidents, the expected losses of the home country decrease if the output preference abroad increases. This is due to the increase in the efforts of the central bank with respect to the stabilisation of the two economies.



Figures 21 and 22

V. Conclusions

The welfare implications of the design of a monetary union have been deduced under different output-shock scenarios. The central-bank council may consist of a central-bank board and a group of national central-bank presidents. While the board addresses the currency area as a whole in its decisions, here, the national presidents are assumed to be interested in their home economies only.

We begin by turning to the attractiveness of a central-bank council consisting of both a central-bank board and a group of national central-bank presidents and start with the absence of labour mobility. For output shocks in one country and negatively correlated output shocks, the expected loss of the central-bank council is greatest in two cases. First, the loss is maximal if the two member countries of the currency union are of the same size and this is independent from the composition of the council. Then, little policy action is taken by the central bank. Second, in the case of a central-bank council composed solely of a group of national presidents, again little stabilisation policy is conducted owing to the equal weighting of the welfare of the two countries in the central-bank loss function. Next, in all output-shock scenarios, a small country prefers decisions to be taken by a group of national presidents while a large country favours monetary-policy decisions to be taken by the central-bank board. The small country opts for a strong position for the group of national presidents in the central-bank council since the more important the group of national presidents the more impact the small country has on the monetary decision process. In the case of the

board the greater importance of the large country to the currency union as a whole is reflected in its large weight in the monetary decision-taking process.

Von Hagen and Süppel (1994) find that besides the negative welfare implications of the national presidents' interest to use monetary policy to stabilise their own economies in the face of shocks, they are confronted with a higher degree of policy uncertainty, and this renders their response to union-wide shocks inadequately small. According to von Hagen (2000a), under majority rule, the strong position of the group of national presidents makes common monetary policy react to country-specific shocks and neglects the stabilisation of the aggregate shocks of the currency area. Provided the ECB cares about euro-area aggregates, Dornbusch, Favero and Giavazzi (1998, p. 22) see the central bank respond more intensively to a country-specific shock the higher the weight of the country of origin in the currency area. However, the results obtained by Dixit (2001) question the fact that the limited pursuit of national interests by the central-bank presidents of the member countries prevents the supranational central bank from performing well. Provided, under majority rule, the median voter decides on monetary policy, voting according to the national interests yields moderate inflation rates. Besides, the outcome is not affected by the countries with extreme preferences. In addition, Aksoy, de Grauwe and Dewachter (2002) find that for the European monetary union composed of the initial 11 member countries, it hardly matters whether the monetary decisions are taken solely by the board of the ECB or by the complete council of the ECB consisting of the board and of the group of national central-bank presidents, in accordance with the ECB statute. Thus, the existing asymmetries are not strong enough to make the policy decisions under these two types of voting procedure diverge to a significant extent.

Though, the council of the ECB contains the group of national central-bank presidents, it is expected to conduct an optimum monetary policy for the euro area as a whole. This is guaranteed by its Statute which require the national central-bank presidents to look at the euro-area aggregates. With the expected enlargement of EMU, the European Council approved an amendment to the Statute of the ESCB on 21 March 2003. This amendment provides for time-restricted voting of the national central-bank presidents by a rotation scheme (see ECB (2004a, p. 12). As this scheme plans to give larger countries longer voting periods, some kind of country-size voting weights are introduced. This is expected to allow for

decision taking in a timely and efficient way. With respect to the analysis above, this would also render some national voting by the central-bank presidents of the euro-area member countries less harmful to the currency area as a whole.

Furthermore, the analysis above reveals that the composition of the central-bank council is less relevant to the member countries the higher the degree of labour mobility. An increase in the degree of labour mobility makes the differences in the adequate stabilisation policies between the countries vanish. Under perfect labour mobility, and with the same national monetary transmission processes and relative output preferences, the central-bank board and the national central-bank presidents agree on their favoured policy actions. But the relative size of the country in which the shock originates is still relevant to the expected losses in the member countries. If the shock occurs in the large country, owing to migration, it strongly affects the economies of the currency area. In the case of negatively correlated output shocks, the expected losses of the countries are the lower the more similar the two countries are in size. Thereupon, these findings are in line with those of Bayoumi (1994).

In addition, the analysis considers differences in the national monetary transmission processes. In the case of output shocks originating in one country and the absence of labour mobility, the central-bank board and the group of national presidents are confronted with lower expected losses if the monetary transmission process is more efficient in the country in which the shock occurs. If perfect labour mobility is assumed, the expected loss of the central-bank board is smaller, the higher the transmission coefficient of the large country in particular. The group of national central-bank presidents suffers the lowest level of loss if the monetary transmission coefficients in both countries are high and if they deviate somewhat. By contrast, the member countries of a currency union are best off when their transmission coefficients are high and similar to each other.

Finally, we return to equal national transmission processes and bring to the fore the different relative output preferences of the member countries. In the absence of labour mobility, the expected losses of both types of central-bank council increase with a higher weight to the output objective abroad. Provided monetary decisions are taken by a group of national presidents, with a higher output preference, a country benefits from the central bank's greater stabilisation efforts to respond to its concerns or from the lesser degree of stabilisation policy with respect to the

neighbouring country. Under perfect labour mobility, and output shocks in one member country, the central-bank board and the group of national presidents first face larger expected losses before a further increase in one country's output preference makes the losses decrease again. The losses of the countries decrease if one country increases its output preference.

Thus, the optimum design of a central bank depends on the preferences of the member countries and on the stochastic structure of the shocks occurring in the individual member countries of the currency union. Since these aspects may vary over time, the optimum constitution of a monetary union should allow for amendments (see also von Hagen and Süppel (1994)). Besides, a change in shock behaviour or in the correlation of national business cycles can be caused by a currency-regime shift. Thus, these criteria/scenarios do not have to be exogenous to the analysis. This implies that a new currency regime may become favourable ex post, or it loses its attractiveness in the event of different shock responses ex ante and ex post to a regime shift (see Frankel and Rose (1997 and 1998)).

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Summary

Welfare Implications of the Design of a Currency Union in Case of Member Countries of Different Sizes

In the study, the relevance of several optimum-currency-area (OCA) criteria is formally worked out in a welfare approach. The optimum monetary-policy rules of the supranational central bank are derived by employing the Barro-Gordon framework, and consideration is given to how the welfare of the member countries of a

currency union is affected by symmetric and asymmetric national output shocks. The central-bank council may consist of a central-bank board and of a group of national central-bank presidents, where the national presidents are assumed to focus on their home economies. In a two-country framework, the countries are allowed to differ in size, and different degrees of labour mobility are addressed. The welfare implications are both deduced analytically and with the use of simulations. It is shown that relatively small member countries favour a situation where the group of national central bank presidents is in a strong position while large countries prefer decisions to be taken by the central-bank board. The preferences are the stronger the lower the degree of labour mobility. Besides, differences in the national monetary transmission processes as well as divergent national inflation and output preferences affect welfare. (JEL E52, E58, E61)

Zusammenfassung

Wohlfahrtsimplikationen des Aufbaus einer Währungsunion im Falle unterschiedlich großer Mitgliedsländer

In dem Artikel werden einige der Kriterien optimaler Währungsräume im Rahmen eines formalen Wohlfahrtsmodells aufgegriffen. Es wird der Frage nachgegangen, wie die Wohlfahrt der Mitgliedsländer einer Währungsunion durch symmetrische und asymmetrische nationale Outputschocks beeinflusst wird. Die Bestimmung der Implikationen für die Wohlfahrt geschieht sowohl analytisch als auch mithilfe von Simulationen. Dazu werden die optimalen geldpolitischen Regeln der supranationalen Zentralbank unter Verwendung des Barro-Gordon-Ansatzes hergeleitet. Der Zentralbankrat kann aus einem Zentralbankdirektorium und einer Gruppe nationaler Zentralbankpräsidenten bestehen. In der Analyse wird den nationalen Präsidenten unterstellt, dass sie nur ihre eigenen Ökonomien im Blick haben. In einem Zwei-Länder-Modell können die Volkswirtschaften verschieden groß sein und es kann unterschiedliche Grade der Arbeitsmobilität geben. Es wird gezeigt, dass relativ kleine Mitgliedsländer eine starke Position der Gruppe der nationalen Zentralbankpräsidenten begrüßen, während große Länder geldpolitische Entscheidungen durch das Zentralbankdirektorium bevorzugen. Die Präferenzen sind umso stärker ausgeprägt je niedriger die Arbeitsmobilität. Darüber hinaus beeinflussen Unterschiede in den nationalen monetären Transmissionsmechanismen und unterschiedliche nationale Inflations- und Outputpräferenzen die Wohlfahrt.

Résumé

Implications d'une union monétaire sur le bien-être des Etats membres de tailles différentes

Cet article reprend quelques-uns des critères des zones monétaires optimales dans le cadre d'un modèle de bien-être formel. L'auteur analyse comment le bien-être des Etats membres d'une union monétaire est influencé par des chocs d'output nationaux symétriques et asymétriques. Les implications pour le bien-

être sont déterminées d'une part de manière analytique et d'autre part par des simulations. Les règlements de la politique monétaire optimale de la banque centrale supranationale en sont déduits en utilisant le modèle de Barro-Gordon. Le conseil de la banque centrale peut se composer d'un Directoire de banques centrales et d'un groupe de présidents nationaux de banques centrales. Dans l'analyse, on part de l'hypothèse que les présidents nationaux ne regardent que leurs propres économies. Dans un modèle à deux pays, les économies peuvent avoir des tailles différentes et il peut y avoir différents degrés de mobilité du travail. L'auteur montre ici que des Etats relativement petits souhaitent une forte position du groupe des présidents nationaux des banques centrales tandis que les plus grands pays donnent la préférence aux décisions politiques prises par le Directoire de la banque centrale. Les préférences sont d'autant plus prononcées que la mobilité du travail est faible. De plus, le bien-être est influencé par des différences dans les mécanismes nationaux de transmission monétaire et par des préférences nationales différentes d'inflation et d'output.