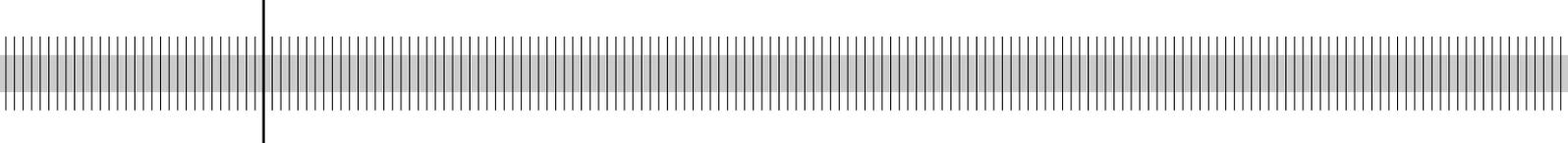


Welfare Implications of the Design of a Currency Union in Case of Member Countries of Different Sizes and Output Persistence

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Abstract:

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 within 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 welfare implications are deduced both analytically and with the use of simulations. In a two-country framework, the countries are allowed to differ in size, and different degrees of labour mobility are addressed. Also the issue of output persistence is taken up. 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. 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 less strong the higher the degree of labour mobility. With output persistence, labour migration also moderates the disadvantages of the decisions taken by a central-bank board for a relatively small country. Furthermore, for output persistence in conjuncture with labour migration, monetary policy by a small country within the group of national presidents may negatively affect its future welfare. Besides, differences in the national monetary transmission processes as well as divergent national inflation and output preferences affect welfare.

Keywords: monetary union, voting power, shocks, output persistence, monetary transmission process, central bank council, labour mobility

JEL-Classification: E52, E58, E61

Non Technical Summary

With the launch of European monetary union, the design of a central-bank council for a currency area composed of different nations is of practical relevance. The issue is readdressed in the context with the expected enlargement. Probably more so than regions in large economies, countries in a currency union may be characterised by different business cycles and monetary transmission processes that may converge over time. Besides, nations may differ in their ideas about a desirable inflation rate and output targets. In a monetary union, the supranational central bank can pursue only one monetary policy and it should be designed to reach an optimum for the currency area as a whole. The European Central Bank is expected to cope with this task. Its design integrates both the members of the executive board and the national central-bank presidents into the central-bank council where everyone has one vote. Besides, the statutes require the national central-bank presidents to look at the currency area as a whole. By contrast, a supranational central-bank council with national central-bank presidents that put the interests of their respective countries first might lead to a different monetary policy outcome. The weighting of the central-bank board and the group of national central-bank presidents within the council then has monetary policy implications and is therefore crucial for the member countries, especially if they differ in size. The study addresses this issue in detail. In this context, it deals with the aspects of asymmetric shock scenarios, different monetary transmission processes and divergent output preferences and shows that the more varied these issues are across the members, the more countries of different sizes have preferences for a particular composition of the central-bank council. A small country often favours the group of national central-bank presidents, which attributes the same weight to each president, being in a strong position while a large country is better off under the decisions of a central-bank board as the board takes the relative country sizes of the members of the monetary union into account. These preferences diminish or disappear when the labour forces within the monetary union migrate since, through migration, the economic differences between the countries are reduced or even offset. Furthermore, in the case of output persistence in conjunction with labour migration, monetary policy by a small country within the group of national presidents may adversely affect its future welfare.

Nicht technische Zusammenfassung

Seit der Schaffung der Europäischen Währungsunion hat die Frage der Ausgestaltung eines Zentralbankrats für einen Währungsraum, der mehrere Länder umfasst, eine praktische Bedeutung erlangt. Sie ist im Zusammenhang mit der erwarteten Erweiterung erneut in den Blick gerückt. Wahrscheinlich stärker als Regionen in einer großen Volkswirtschaft sind die Länder einer Währungsunion durch unterschiedliche Konjunkturverläufe und unterschiedliche monetäre Transmissionsmechanismen geprägt, die sich ggf. jedoch im Laufe der Zeit angleichen. Außerdem können unterschiedliche Vorstellungen der einzelnen Mitgliedsländer zu einer wünschenswerten Inflationsrate und zu einem wünschenswerten Outputvolumen für das Währungsgebiet vorliegen. In einer Währungsunion kann die supranationale Zentralbank nur eine Geldpolitik betreiben, die optimal in Hinblick auf den gesamten Währungsraum sein sollte. Die Statuten der Europäischen Zentralbank sind auf diese Erfordernisse ausgerichtet worden. Das Entscheidungsgremium der EZB setzt sich aus den Mitgliedern ihres Direktoriums und den nationalen Zentralbankpräsidenten des Währungsraums zusammen. Dabei hat jedes Gremiumsmitglied eine Stimme im Abstimmungsprozess. Ferner verpflichten die Statuten der EZB die nationalen Präsidenten darauf, bei ihren Entscheidungen das Wohl des gesamten Währungsraums zu verfolgen. Hingegen würde ein supranationaler Zentralbankrat mit Zentralbankpräsidenten der Mitgliedsländer, die vorrangig die Interessen ihrer Länder vertreten, zu anderen geldpolitischen Entscheidungen gelangen. In diesem Fall hätte die Gewichtung des Direktoriums, das den gesamten Währungsraum im Blick hat, und die der Gruppe der nationalen Präsidenten im Zentralbankrat Auswirkungen auf die Geldpolitik. Sie wäre vor allem dann von Relevanz für die einzelnen Mitgliedsländer, wenn diese sich in ihrer Größe unterschieden. Auf diesen Punkt geht das vorliegende Arbeitspapier näher ein. Darauf abgestellt werden die Bedeutung asymmetrischer Schocks, unterschiedlicher monetärer Transmissionsmechanismen und unterschiedlicher relativer Outputpräferenzen aufgegriffen. Bei der Vorlage von nationalen Asymmetrien würde ein kleines Land eine starke Position der Gruppe der nationalen Präsidenten, in der jedem Präsidenten unabhängig von der Größe des Landes, dem er vorsteht, die gleiche Bedeutung beigemessen wird, bevorzugen. Hingegen würde

ein großes Land in diesem Fall Entscheidungen, die von dem Zentralbankdirektorium getroffen werden, begrüßen. Diese Präferenzen gehen zurück bzw. verschwinden, wenn die Arbeitskräfte innerhalb der Währungsunion beim Auftreten von Schocks migrieren, da Migration die ökonomischen Unterschiede zwischen den Ländern verringert bzw. abbaut. Ferner führt die Persistenz von realen Ungleichgewichten in einzelnen Ländern in Verbindung mit Migration dazu, dass die Geldpolitik, die ein kleines Land innerhalb der Gruppe der nationalen Präsidenten betreibt, negative Auswirkungen auf seine zukünftige Wohlfahrt haben kann.

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Welfare Implications of the Design of a Currency Union in Case of Member Countries of Different Sizes and Output Persistence* **

1 Introduction

Exchange-rate regimes had been widely discussed in the past and have been 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 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 USA. Euro-area GDP reached EUR 7.1 billion while that of the USA was EUR 9.4 billion (see ECB (2004, p 7)).

Besides this study, there are already a large number of articles that treat the relevance of the optimum-currency-area criteria. In particular, Aksoy, de Grauwe and Dewachter (2002) already deal with several of the aspects that are taken up in a different way

* I am indebted to the participants of the ESEM conference 2001 in Lausanne (Switzerland) and the research seminar at the University of Helsinki in December 2001 for comments on the first part of the paper. Besides, the paper benefited from discussion in the research seminar at the Deutsche Bundesbank in April 2004. In particular, I am very grateful to Falko Fecht, Heinz Herrmann, Seppo Honkapohja, Thomas Knetsch, Michael Rauscher and Ulf von Kalckreuth for constructive criticisms.

** Deutsche Bundesbank, Economics Department, email: rainer.frey@bundesbank.de. The paper represents the authors' personal opinions and does not necessarily reflect the views of the Bundesbank.

below. As in this study, they consider different preferences in the various euro-area countries, different national monetary transmission processes and asymmetric shocks. The objective of the central bank is to minimise the expected loss caused by deviations of the inflation rate from an inflation target and of the output level from an output-gap target, and by interest-rate changes. 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. They find that within EMU, the existing asymmetries are not strong enough to make the policy decisions under these two types of voting procedure diverge to a significant extent. 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. Von Hagen (2000a and 2000b) also considers the relevance of the composition of the Governing Council to the decisions of the ECB. Von Hagen shows that, since decisions in the ECB Governing Council are taken by majority vote, the mean voter gets his preferred inflation rate. As below, Dixit (2001) also considers 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, the monetary decisions are taken by national central-bank presidents with national interests, and 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) consider 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. Additionally, von Hagen and Süppel see a conflict between the efficient stabilisation of the real economy and long-run price stability. They propose

that the group of national presidents should address the long-run course while the central-bank council should be responsible for the stabilisation of the real economy.

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, the degree of labour mobility and of output persistence are issues that have been neglected in large parts of the existing literature in this field. However, these aspects have important implications as they make the composition of the central-bank council crucial for the welfare of the member countries of the currency area as a whole. Starting out from this framework, the conduct 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.¹

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. 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. Additionally, the central bank pursues an output target to moderate business cycles.² 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)). In this connection, output persistence may be considered (see Lockwood, Miller and Zhang (1998)).

¹ Though this study takes up quite a lot of issues of the optimum-currency-area literature, it is still far way from a complete analysis. Credibility aspects and microeconomic issues in particular are dropped, e.g. dynamic efficiency gains of a currency union. Also within the Barro-Gordon framework, some of the issues above are investigated for the regimes of flexible and fixed exchange rates in Frey (2004).

² Empirically, 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).

This paper is organised as follows. The structure of the model is presented in Section 2. Section 3 presents the optimal inflation-rate rules depending on the composition of the central-bank council. With different shock scenarios, Section 4 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 5 concludes.

2 The model

2.1 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.³ 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:⁴

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

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

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 $0 \leq d \leq 1 + b$.

³ In contrast to the study below, in Tarkka (1997) the common monetary policy is addressed in the light of an external transfer system. Thus, in the loss function, the argument of transfers is added to the arguments of inflation and output.

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

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.⁵

2.2 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. For the loss in period t , 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 :

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

where k is the weight of the loss suffered by the central-bank board, L_t^{board} , and $(1-k)$ that to 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. They address the weighted sum of the losses that occur in the member countries and with respect to period t , we can write:^{6 7}

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

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

and where b_π^{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.⁸

⁵ 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 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.

⁶ Besides, the board may consider a loss function including the aggregate values of inflation and output of the currency area.

⁷ The loss faced by the board may also be interpreted as a welfare measure of the currency area as a whole.

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. 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.⁹

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

$$L_t^{pres} = \frac{1}{2} L_t + \frac{1}{2} L_t^a . \quad (5)$$

2.3 The monetary transmission processes in the member countries and labour mobility

The transmission of monetary policy to the real economy is described by the Phillips-curve relationship. The Phillips curve may be characterised by output persistence. Thus, we first address the case of the absence of output persistence before we turn to the scenario of output persistence.

No output persistence

In the two countries the Lucas-type supply functions are given by

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

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

with

$$\alpha^a = c \alpha , \quad (8)$$

where π_t^{de} is the union-wide inflation rate that is expected in period $t-1$ for period t , and ε_t (ε_t^a) is the effect of an iid supply shock with mean 0 and variance σ^2 ($(\sigma^a)^2$) at home (abroad). α and α^a are the domestic and foreign sacrifice ratios of variations in

⁸ Dixit's country weights are chosen according to relative economic sizes and political powers (see Dixit (2001, p 603)).

⁹ By contrast, one may think of a situation in which one country is permanently more often affected by shocks than the other country may only agree with the establishment of a currency union when it is attributed more weight in decision taking.

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 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:¹¹

$$\pi_t^{de} = E_{t-1} \pi_t^d, \quad (9)$$

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

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

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 According to Evans and Honkapohja (2000), optimal monetary policy should not assume rational expectations. The central bank should consider observed private expectations in its policy rule. In Evans's and Honkapohja's model, both the learning behaviour of the central bank about structural parameters and the private-agents' learning behaviour are considered.

was full employment in the other country before, then the inflow of migrants would create unemployment provided wages were rigid.¹²

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 shocks that the countries face after the completion of the migration process are the relocated effects of the initially national shocks:¹³

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

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

where ε_t (ε_t^a) is the effect of supply shocks at home (abroad) after migration has finished, ε_t' ($\varepsilon_t^{a'}$) 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. Thus, in the absence of output persistence, the effects of labour mobility already happen within the period in which the shock occurs. 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).

Output persistence

Above, it is assumed that output disequilibria in one period do not affect the output levels in the successive periods. However, we often observe that a boom or a recession

¹² The issue that migration can ameliorate the situation in one country while the other country is negatively affected is captured in a simulation model by Beine and Docquier (1998, p 241 f).

¹³ 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.

prevails for several periods.¹⁴ Thus, it makes sense to allow for output persistence in our specification.

The consideration of output persistence means that we have to include the lagged output level on the right-hand side of the output-supply equations at home and abroad, equations (6) and (7):¹⁵

$$y_t = (1-r)\bar{y} + ry_{t-1} + \alpha(\pi_t^d - \pi_t^{de}) + \varepsilon_t', \quad (12)$$

$$y_t^a = (1-r^a)\bar{y}^a + r^a y_{t-1}^a + \alpha^a(\pi_t^d - \pi_t^{de}) + \varepsilon_t^{a'}, \quad (13)$$

where r (r^a) \in (0;1) is the degree of output persistence at home (abroad), and \bar{y} (\bar{y}^a) is the natural level of output at home (abroad).

In the case of labour mobility, the economy facing a shock is relieved while the other country is confronted with a spill-over effect that results in some destabilisation. Here, the framework with output persistence allows us to model the occurrence of labour migration with a delay and only that share of the effect of the shock which persists is partly spilled over to the neighbouring country by migration:

$$y_t = (1-r(un + (1-u)) - r^a u(1-n))\bar{y} + r(un + (1-u))y_{t-1} + r^a u(1-n)y_{t-1}^a + \alpha(\pi_t^d - \pi_t^{de}) + \varepsilon_t', \quad (14)$$

$$y_t^a = (1-r^a(u(1-n) + (1-u)) - run)\bar{y}^a + r^a(u(1-n) + (1-u))y_{t-1}^a + runy_{t-1} + \alpha^a(\pi_t^d - \pi_t^{de}) + \varepsilon_t^{a'}. \quad (15)$$

Again, we can see that the relevance of the spill-over effects depends on the degree of labour mobility, u , and the relative sizes of the two member countries, n and $1-n$. In addition, the degree of output persistence, r or r^a , has an impact on the transmission of the effects of the shocks to the other country.

¹⁴ Levy and Dezhbakhsh (2003) find empirical evidence that output shock persistence varies across countries.

¹⁵ Output persistence is also considered by Lockwood et al. (1998), Johnsson (1997) and Svensson (1997), for example.

3 Monetary policy without output persistence

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. As output persistence is dropped at this place, a static minimisation problem arises:¹⁶

$$\min_{\pi_t^d, \pi_t^{de}} E(L_t^{cb}), \quad (16)$$

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

The first-order conditions are

$$\begin{aligned} & (kb_{\pi}^{cb} + (1-k)0.5(1+(1+b-d)))(\pi_t^d - \pi^*) \\ & + k[nb_y^{cb}\alpha(y_t - y^*) + (1-n)b_y^{cb}\alpha^a(y_t^a - y^*)] \\ & + (1-k)0.5[b\alpha(y_t - y^*) + d\alpha^a(y_t^a - y^*)] + \theta_{t-1} = 0, \end{aligned} \quad (17)$$

$$\begin{aligned} & -kE_{t-1}[nb_y^{cb}\alpha(y_t - y^*) + (1-n)b_y^{cb}\alpha^a(y_t^a - y^*)] \\ & - (1-k)0.5E_{t-1}[b\alpha(y_t - y^*) + d\alpha^a(y_t^a - y^*)] - \theta_{t-1} = 0, \end{aligned} \quad (18)$$

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

By inserting equation (17) into equation (18), we obtain:

$$\begin{aligned} & (kb_{\pi}^{cb} + (1-k)0.5(1+(1+b-d)))(\pi_t^d - \pi^*) \\ & + k[nb_y^{cb}\alpha(y_t - y^*) + (1-n)b_y^{cb}\alpha^a(y_t^a - y^*)] \\ & + (1-k)0.5(b\alpha(y_t - y^*) + d\alpha^a(y_t^a - y^*)) \\ & - kE_{t-1}[nb_y^{cb}\alpha(y_t - y^*) + (1-n)b_y^{cb}\alpha^a(y_t^a - y^*)] \\ & - (1-k)0.5E_{t-1}[b\alpha(y_t - y^*) + d\alpha^a(y_t^a - y^*)] = 0. \end{aligned} \quad (19)$$

¹⁶ 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)).

Equations (6), (7) and (19) imply that the expected inflation rate equals the socially desirable inflation target:

$$\pi_t^{de} = \pi^*. \quad (20)$$

With equations (6), (7), (19) and (20) the optimal inflation rule is

$$\pi_t^d = \pi^* - \frac{knb_y^{cb}\alpha + (1-k)0.5b\alpha}{f^k} \varepsilon_t - \frac{k(1-n)b_y^{cb}\alpha^a + (1-k)0.5d\alpha^a}{f^k} \varepsilon_t^a, \quad (21)$$

$$\text{with } f^k = kb_{\pi}^{cb} + (1-k)0.5(1+(1+b-d)) \\ + kb_y^{cb}(n\alpha^2 + (1-n)(\alpha^a)^2) + (1-k)0.5(b\alpha^2 + d(\alpha^a)^2).$$

Provided $\alpha = \alpha^a$ and $b = d = b^{cb}$, equation (21) can be simplified:

$$\pi_t^d = \pi^* - b\alpha \frac{kn + (1-k)0.5}{1+b\alpha^2} \varepsilon_t - b\alpha \frac{k(1-n) + (1-k)0.5}{1+b\alpha^2} \varepsilon_t^a. \quad (22)$$

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.

4 Monetary policy with output persistence

We have seen above that, in the absence of output persistence, the minimisation done by the central bank was described by a static optimisation setting. However, output persistence requires the consideration of dynamic aspects by the central bank. For a supranational central bank confronted with output persistence, it is no longer sufficient to focus solely on the welfare arising in the period in which the shock arises: it also has to take into account the welfare implications of both the effects of the shock and its policy for the successive periods. Therefore, in this section, the central bank council minimises the sum of the present and time-discounted future losses. As the central bank

may be interested in the near future in particular, we may assume a finite time horizon for its optimisation.¹⁷

Besides, since the central bank tries to avoid an inflationary bias, monetary policy is solely conducted in the period with the shock, period t . The reason is that, after period t , no monetary surprises are possible in equilibrium: A conflict of persisting output disequilibria across the periods would affect the expectations of the private sector and, owing to this, would result in an inflation bias only.

Again, the objective function of the central- bank council is composed of that of the central-bank board and that of the group of the national central-bank presidents, who are interested in the losses over a particular time horizon from periods t to T :

$$L_t^{cb,T} = kL_t^{board,T} + (1-k)L_t^{pres,T}, \quad (23)$$

where $L_t^{cb,T}$, $L_t^{board,T}$ and $L_t^{pres,T}$ are the losses faced by the central bank council, the board and the group of national presidents over the time horizon from periods t to T .

The loss of the group of national presidents is the sum of those of the presidents who are attributed equal weight:

$$L_t^{pres,T} = \frac{1}{2}L_t^T + \frac{1}{2}L_t^{a,T}, \quad (24)$$

where L_t^T and $L_t^{a,T}$ are the losses of the presidents at home and abroad for the periods t to T .

The sums of the time-discounted period losses can be written as:

$$L_t^{board,T} = \sum_{i=0}^{T-1} \left((s^{board})^i L_{t+i}^{board} \right), \quad (25)$$

$$L_t^T = \sum_{i=0}^{T-1} \left(s^i L_{t+i} \right), \quad (26)$$

¹⁷ There may be a link between the degree of output persistence and the time horizon addressed by the central-bank council: The more shocks persist, the more the central bank should look into the future.

$$L_t^{a,T} = \sum_{i=0}^{T-1} ((s^a)^i L_{t+i}^a), \quad (27)$$

where $s^{board}, s, s^a \in [0;1]$ are the discount factors of time of the central-bank board and the domestic and foreign central-bank presidents.

Thus, we can write the optimisation approach of the central-bank council in the case of output persistence in the following way:

$$\min_{\pi_t^d, \pi_t^{de}} E(L_t^{cb,T}), \quad (28)$$

subject to equations (1), (2), (4), (9), (14), (15), (23), (24), (25), (26) and (27).

As the minimisation leads to rather complex results, the policy rules are not explicitly calculated and the analysis is restricted to the simulated welfare effects below.

5 Welfare analyses for different shock scenarios

5.1 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. 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.¹⁸

¹⁸ 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.

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. Below, we first turn to the case of no output persistence. Here, $b = 0.5$ 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.¹⁹ $\alpha = 3$ expresses the assumed inflation-output trade-off in the home country: A 1% increase in domestic surprise inflation makes the domestic output level increase by 3%.²⁰ 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 5.3 and 5.4.

In the scenario with output persistence more parameters have to be fixed as new ones are introduced. Here, we assume that the domestic country is relatively small $n = 0.1$ and the time preferences of the foreign country and the central-bank board are relatively low with discount factors of $s^a = s^{board} = 0.9$. The time horizon contains five periods, thus T is set 5. This is probably a fairly realistic assumption: The central bank looks ahead but there is a limit as, with the passage of time, new events may gain more relevance than the parts of the effects that persist. Besides, the national natural output levels equal zero: $\bar{y} = \bar{y}^a = 0$. The other parameters are kept at the levels also assumed for most of the other sections: $\alpha = \alpha^a = 3$, $b_\pi = b_\pi^a = b_\pi^{cb} = 1$ and $b = b^a = b^{cb} = 0.5$.

5.2 Welfare implications of the design of the objective function of the central bank (no output persistence)

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.

¹⁹ 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.

Output shocks in the home country

a) Variations in the expected loss of the central bank without labour mobility

These variations are presented by equations (29) and (30) and by Figure 1.

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1} L_t^{cb, \min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{u=0} = -0.5 \frac{bk(b\alpha^2 k(2n-1) - 1)}{1 + b\alpha^2} \leq 0, \quad (29)$$

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1} L_t^{cb, \min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{u=0} = -0.25b \frac{(b\alpha^2 k(2n-1) - 1)(2n-1)}{1 + b\alpha^2} \leq 0. \quad (30)$$

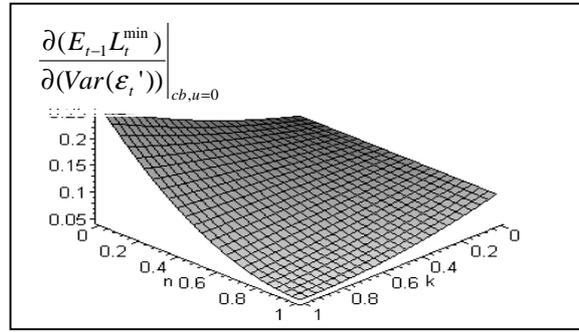


Figure 1

If the central-bank council is composed of only national central-bank presidents, $k = 0$, the expected loss of the central bank is highest. 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

²⁰ 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.

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.

b) 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:

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1} L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{cb, u=0} = -0.5b^2 \alpha^2 \frac{k(1+k-2kn)}{1+b\alpha^2} \leq 0, \quad (31)$$

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1} L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{cb, u=0} = 0.25b^2 \alpha^2 \frac{(2n-1)(1+k-2kn)}{1+b\alpha^2} \leq 0. \quad (32)$$

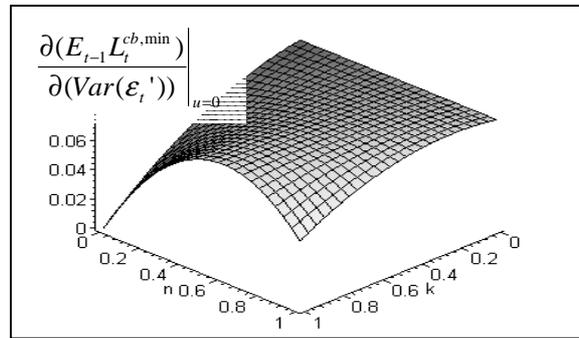


Figure 2

c) 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 (33) 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:

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{u=1} = \left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{cb,u=1} = \frac{bn}{1+b\alpha^2} > 0, \quad (33)$$

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{u=1} = \left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{cb,u=1} = 0. \quad (34)$$

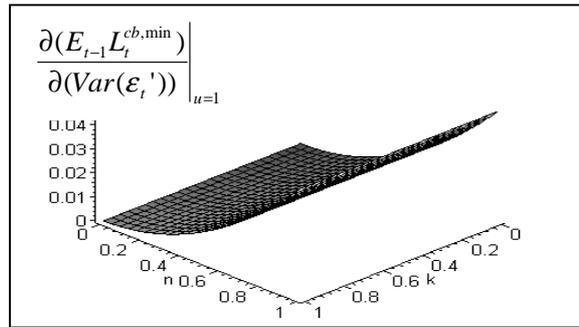


Figure 3

Negatively correlated output shocks in the member countries

a) Variations in the expected loss of the central bank without labour mobility

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{\varepsilon_t^a = -\varepsilon_t', u=0} = \frac{2b^2\alpha^2k^2(1-2n)}{1+b\alpha^2} \leq 0, \quad (35)$$

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{\varepsilon_t^a = -\varepsilon_t', u=0} = -\frac{b^2\alpha^2k(1-4n(n-1))}{1+b\alpha^2} \leq 0. \quad (36)$$

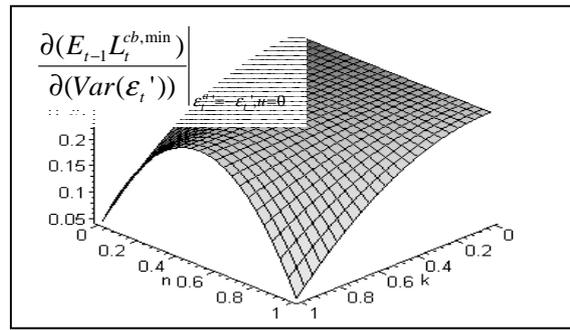


Figure 4

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.

b) 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 (37) and (38) and Figure 5).

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{cb, \varepsilon_t^a = -\varepsilon_t', u=0} = -\frac{b^2 \alpha^2 k(1+k-2kn)}{1+b\alpha^2} \leq 0, \quad (37)$$

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{cb, \varepsilon_t^a = -\varepsilon_t', u=0} = \frac{b^2 \alpha^2 (1-2n)(1+k-2kn)}{1+b\alpha^2} \leq 0. \quad (38)$$

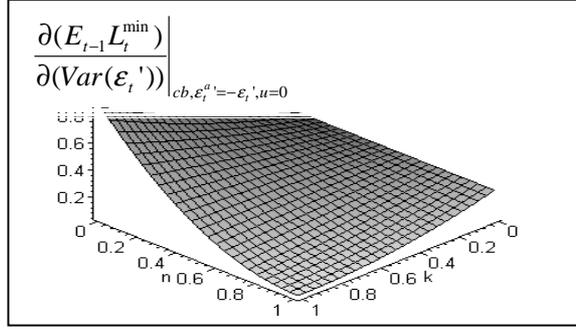


Figure 5

c) 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):

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{cb, \min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{\varepsilon_t^a = -\varepsilon_t', u=1} = \left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial n} \right|_{cb, \varepsilon_t^a = -\varepsilon_t', u=1} = -\frac{2b(1-2n)}{1+b\alpha^2} \leq 0, \quad (39)$$

$$\left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{cb,\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{\varepsilon_t^a = -\varepsilon_t', u=1} = \left. \frac{\partial \left(\frac{\partial(E_{t-1}L_t^{\min})}{\partial(\text{Var}(\varepsilon_t'))} \right)}{\partial k} \right|_{cb, \varepsilon_t^a = -\varepsilon_t', u=1} = 0. \quad (40)$$

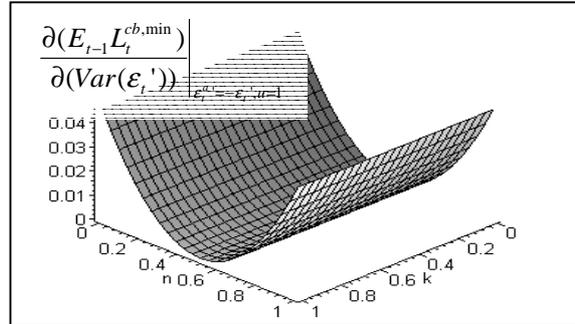


Figure 6

5.3 Welfare implications of different monetary transmission processes in the member countries (no output persistence)

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.²¹

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 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.

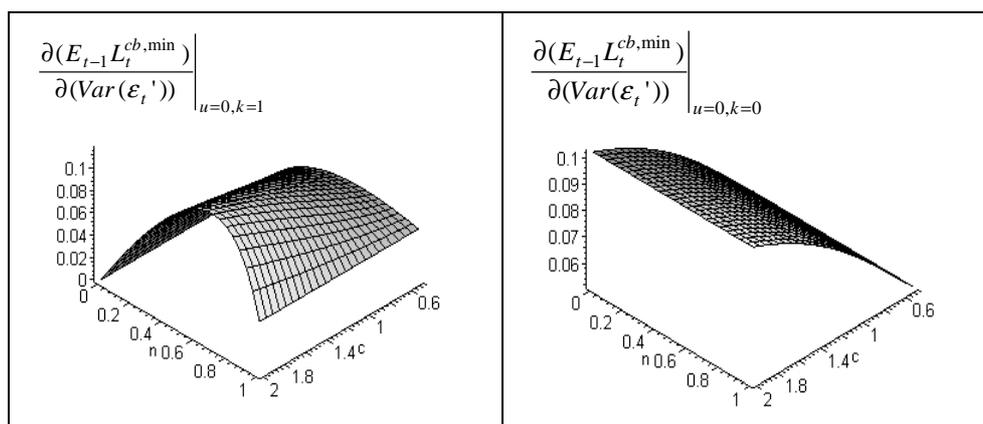
Owing to the complexity of the analytical results, only the graphical presentation of the results is provided.

²¹ Here, the parameter c is restricted to the interval $c \in [0.5; 2]$.

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.

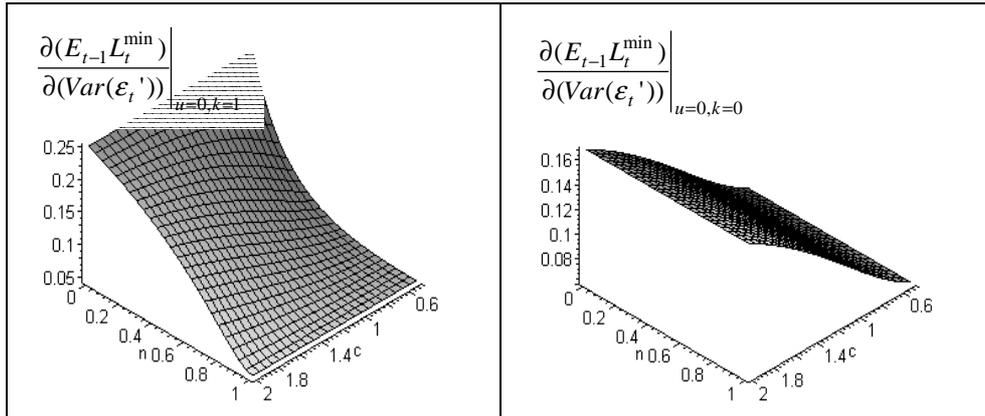


Figures 7 and 8

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

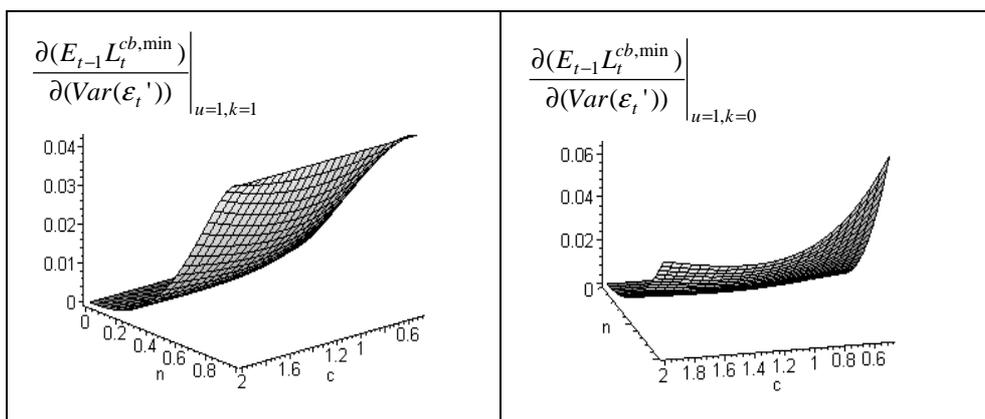
In Figures 9 and 10 it can be seen that the expected loss of the home country increases in the foreign inflation-output trade-off parameter. Then, the central bank reduces its efforts to stabilise the domestic economy since the cost of this policy, the destabilisation of the foreign country, increases. 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

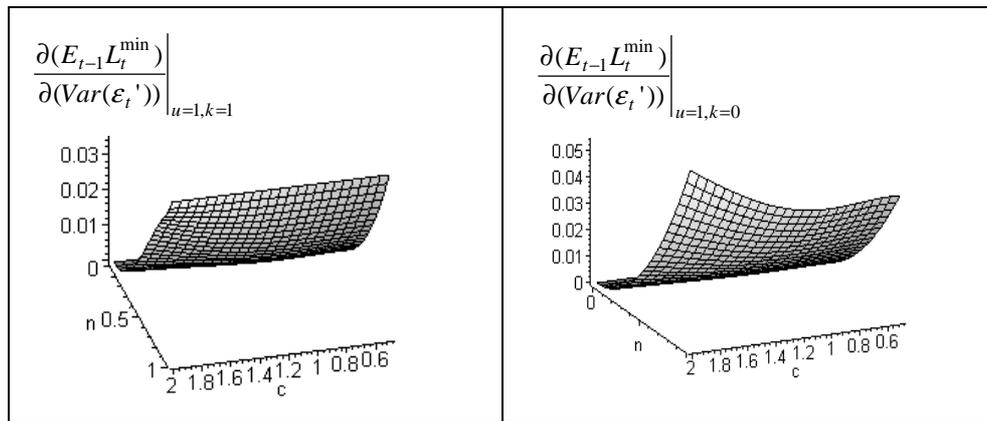
Both types of central-bank council conduct stabilisation policy at low cost if the member countries of the currency union have high and similar inflation-output trade-off parameters. The central-bank board and the group of national central-bank presidents suffer their smallest losses if the monetary transmission coefficient abroad is a bit higher than at home – c somewhat higher than one. Then, in relation to the currency area as a whole, monetary policies become more effective than in the case of equal monetary 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 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 faces maximum welfare provided the neighbouring country has the same 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

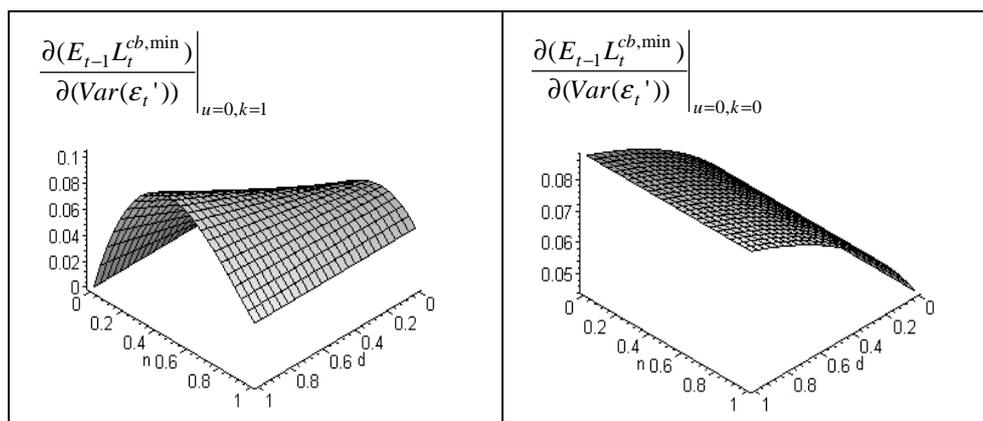
5.4 Welfare implications of different output preferences in the member countries (no output persistence)

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.



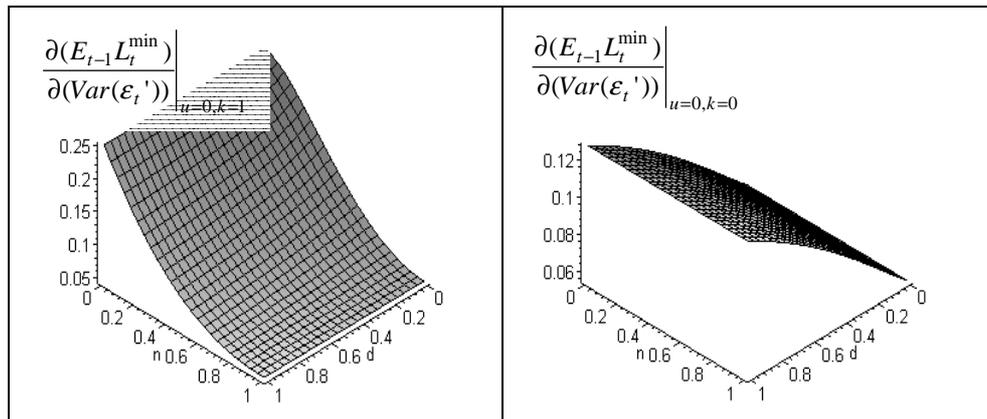
Figures 15 and 16

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

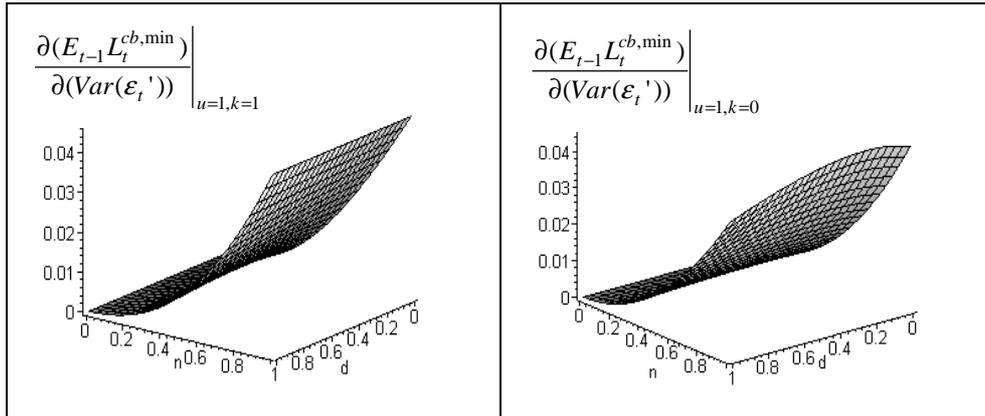
preference of the foreign central-bank president results in a larger expected loss in the home country. The higher the output preference abroad, the larger the expected loss of the foreign country due to some destabilisation of its economy, and therefore the group of national presidents decides to conduct 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

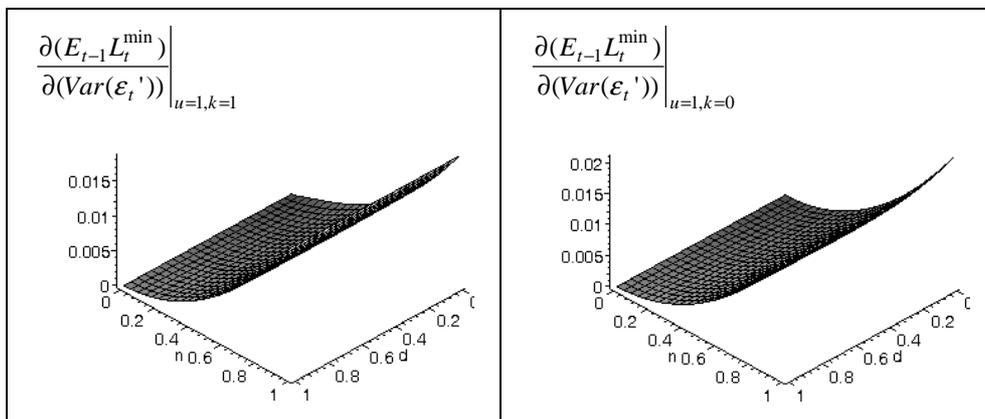
Under labour mobility, the foreign country is also directly affected by the shocks originating at home. In this case, both the expected loss of the board and the expected loss of the group of national presidents first increase before they decrease in a higher output preference of the foreign country (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 and due to the constant output preference abroad.



Figures 21 and 22

5.5 Welfare implications of output persistence

In the sections above, we were able to see the clear result that a small country is best off when the central bank decisions are taken by the group of national presidents. Now, the question arises as to whether this result is preserved under output persistence.

In the figures below, we look at the small domestic country in the case of output shocks at home and in the case of negatively correlated output shocks across the two countries. As we address the relative attractiveness of the monetary decisions taken by the group of national presidents vis-à-vis those of the central-bank board and as the figures with the losses may not deviate much from each other, we here choose the figures that display the differences between the domestic losses arising for the two types of central-bank councils. In the figures below, a negative value indicates that the policy through the national presidents is more favourable to the small domestic country.

Output shocks in the home country

First, we look at the difference in the sum of the domestic losses for the decisions of the two types of central-bank councils over the five periods of concern. In Figure 23, this is done for shocks at home in the case of labour mobility.

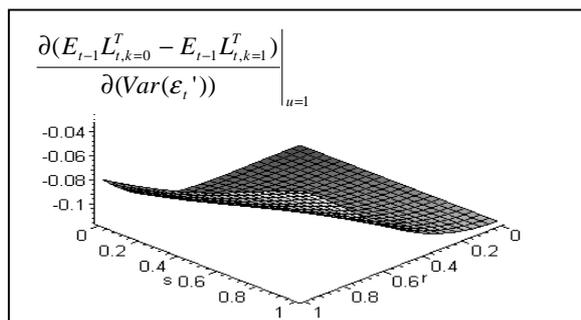


Figure 23

As revealed by the negative values on the vertical axis, here the small domestic country is better off if monetary policy is conducted by the group of national central-bank presidents. We can see that the attractiveness of decisions by the national presidents decreases with an increase in output persistence and with an increase in the discount factor of time at home, s . The higher the output persistence and thus labour migration, the more the country is affected by spill-over effects in the successive periods: On the one hand, it is relieved by the spill over of parts of the effects of the domestic shock that persist. On the other hand, it suffers from effects transmitted from the large economy. The large country is in disequilibrium as it is, to some extent, destabilised in period t by the monetary policy that is conducted with respect to the small domestic country. Thus, the international linkages make the national economic situations and, by extension, the

interests of the national presidents and the board approach each other. Moreover, the greater domestic weight on future losses expressed by a higher discount factor s is accompanied by stronger emphasis on the spill-over effects from and to the foreign country. This also makes the policy proposals of the board and the group of national presidents more similar.

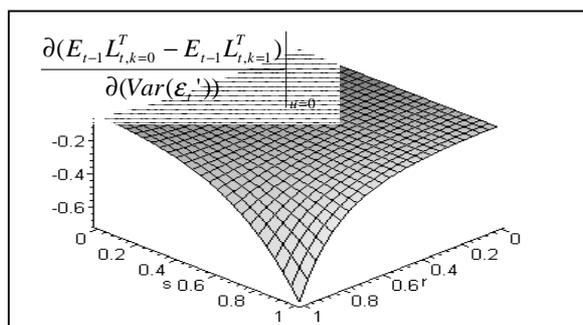


Figure 24

When we consider this shock scenario in the absence of labour mobility, the policy decisions taken by the group of national central-bank presidents are again more advantageous to the small domestic country than are those of the board. However, here the discrepancies between the sums of the domestic losses under decisions of the national presidents and of the board are more pronounced, the higher the degree of output persistence is and the higher the weight on future losses at home. The reason for this is that the monetary policy of the board, which focuses on the concerns of the large foreign country, leads to the stabilisation efforts desired by the small domestic country to a smaller extent than is the case for the monetary policy of the group of national presidents. This is attributed to the fact that the board puts the potential accompanying destabilisation of the large country in first place by design. The situation for the small domestic country becomes even worse with output persistence. Then, the disequilibrium at home would be maintained over some periods. By a higher weight on the future domestic losses, a higher s , the persisting disequilibria gain importance for the small domestic country, which also results in a larger difference between decisions of the group of national presidents and the board owing to the different stabilisation efforts with respect to the small country.

Last, the differences in the losses of the domestic country suffered just in period $t + 1$ for labour mobility are considered (see Figure 25). Again, monetary-policy decisions

consider a time horizon of five periods. By the positive values on the vertical axis, we can see here that decisions taken by the central-bank board are preferable for the small country. Thus, while the sum of the domestic losses over five periods is higher for board decisions, the board decision reduces the expected loss in period $t + 1$.

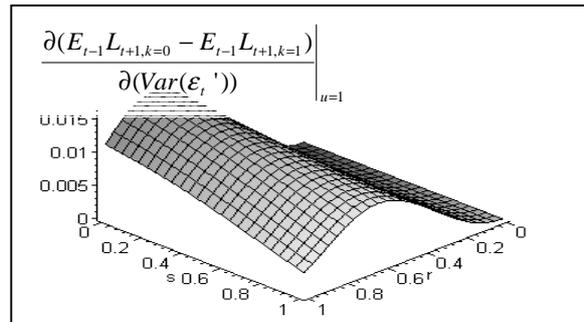


Figure 25

As the board attaches great importance to the concerns of the large foreign country, it pays much attention to the avoidance of high destabilisation of the foreign country in period t . By doing this, the spill-over effects from the large foreign country to the small domestic country via labour migration in the successive periods are reduced. By contrast, the group of national presidents focuses on the stabilisation of the domestic country in period t to a greater extent and therefore allows higher negative spill-over effects from abroad in the following periods. The successive spill-over effects are neglected more by the group of presidents, the smaller is the discount factor of time of the domestic national president, s .

By contrast, in the absence of labour mobility, no spill-over effects arise in the following periods and the small domestic country has no incentive to consider the impact of the monetary policy decisions on the other country. As only the small domestic country is negatively affected by the output shock, it prefers a strong position of the group of national presidents in decision-taking. The higher the output persistence is, the more it is affected by disequilibria in the future as well, which increases its desire for decisions by the group of presidents, which gives greater consideration to the small country. The same applies if the small country places greater weight on the welfare of the future periods, a higher s .

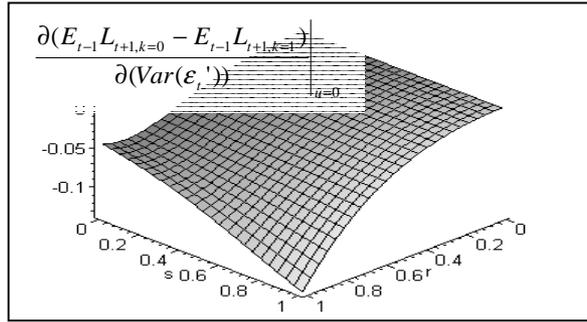


Figure 26

Negatively correlated output shocks

Again, we first concentrate on the difference between the time-discounted sums of the losses of the domestic country for monetary policies conducted by the group of national presidents and by the central-bank board. As above, we can see that, for the scenarios of negatively correlated output shocks and labour mobility, the more output persistence exists, the less the decisions are dependent on the composition of the central-bank council. Output persistence in conjunction with labour mobility is accompanied by international spill-over effects that make the member countries suffer in a more similar way and thus, their policy interests approach each other. Besides, the difference in the sums of the losses decreases with an increase in the time-discount factor of the domestic country. As a low discount factor implies a relatively strong weight on the current period and the near future and as in period t , one country suffers a negative output shock while the other is hit by a positive one, which implies conflicting policy needs: a small country that concentrates on the current period and neglects the spill-over effects in the successive periods has a strong preference for decisions by the group of national presidents, which provides it with more voting power.

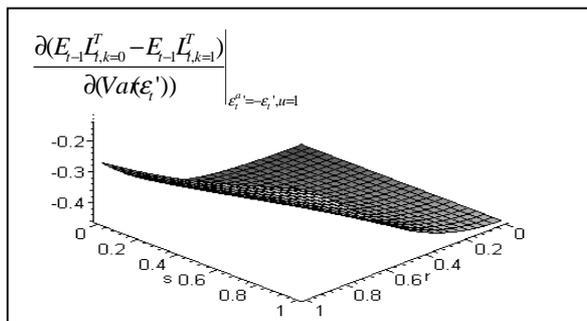


Figure 27

For negatively correlated output shocks and the absence of labour mobility, there is no stabilisation mechanism beside monetary policy that moderates the divergent policy needs over time. Thus, the small country favours a monetary policy conducted by the group of national presidents, where its concerns have more relevance, and the preferences increases with the time-discount factor and the degree of output persistence (see Figure 28).

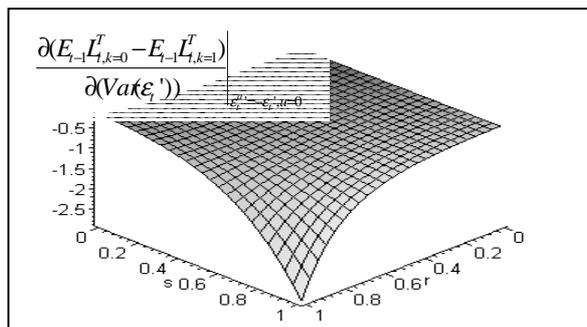


Figure 28

Next, in Figure 29, we turn to the loss suffered by the small domestic country just in period $t + 1$ in the case of labour mobility. Output persistence means that the effects of the shocks last over periods and thus, welfare losses arise in period $t + 1$. Here, policy decisions through the board reduce the loss suffered at home in period $t + 1$. Since the board concentrates its policy measures on the large other country, it combats, in particular, the effects of the shock that initially occurs abroad. The shock abroad also dominates the small domestic economy over their spill-over effects in the following periods.

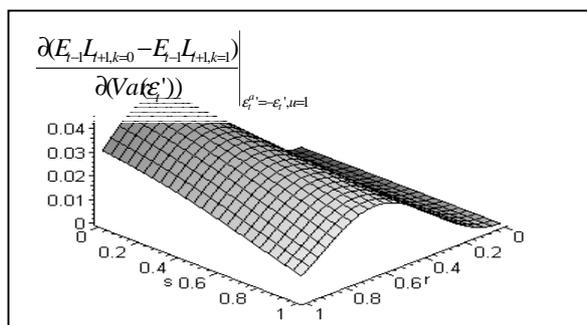


Figure 29

By contrast, if the labour forces cannot migrate, the small country would be affected by unfavourable policy decisions of the board not only in period t but, owing to output

persistence, the economy would be destabilised in the successive periods, too. Moreover, the higher the time-discount factor of the domestic country is, the more it would like to opt for decisions taken by the group of national presidents (see Figure 30).

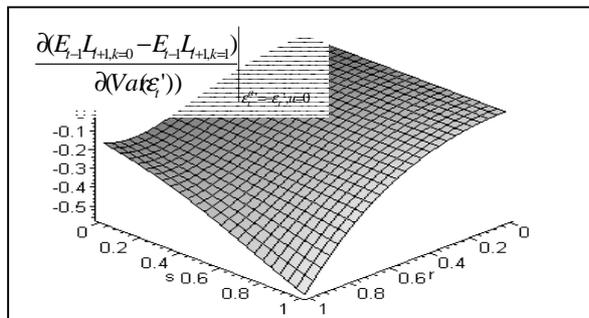


Figure 30

6 Conclusions

The welfare implications of the design of a monetary union have been deduced under different output-shock scenarios. First, the aspect of output persistence is left aside and we begin by turning to a central-bank council consisting of both a central-bank board and a group of national central-bank presidents, where the national presidents are assumed to be interested only in their home economies. For all output-shock scenarios in the absence of labour mobility, the expected loss of the central-bank council is greatest in two cases. First, the loss is maximised 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.

The analysis above reveals that the composition of the central-bank council is the 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. According to Bayoumi (1994), perfect labour mobility even prevents the output costs associated with the formation of a currency union.

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 central-bank board and the group of national central-bank presidents suffer low losses 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 equal each other. Thus, the model above could show the relationships verbally described by Dornbusch, Favero and Giavazzi (1998, p 22): A supranational central bank that cares about the aggregate variables of the currency area responds all the more to country-specific shocks the more important the country of origin, the lower the impact of the union-wide monetary policy on the economy of this country and the less the economy of the other country is affected by the monetary policy actions.

Next, 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.

In the final section, output persistence is introduced. The investigation is done for a relatively small domestic country when output shocks occur at home and when there are negatively correlated shocks in both countries. For a time horizon of the central bank and of the two countries of five periods, a small country is again better off with respect to this time horizon if the decisions are taken by the group of national central-bank presidents. With labour mobility that is linked to output persistence in this section, the composition of the central-bank council becomes less relevant for the small domestic country, the higher the degree of output persistence is and the higher the time-discount factor at home. Then, the economic situation of the large foreign country plays a great part for both countries and the policy proposals of the board and of the group of national presidents approach each other. Here, it has to be taken into account that stabilisation policy with respect to the small domestic country is accompanied by persuasive effects on the foreign economy. With the international spill-over effects in the case of output persistence and labour mobility, these effects become relevant to the small domestic country. If we just take the period after the shock, decisions of the board are even preferable for the small country owing to the major importance of transmitted effects from the foreign country to the small domestic country. However, in the absence of labour mobility, for more output persistence and a higher time-discount factor, the economic situation at home is aggravated if the decisions are taken by the board; the domestic country is then unconcerned about spill-over effects in the successive periods and does not welcome stabilisation measures with respect to the large foreign country.

Thus, the optimum design of a central bank with respect to the member countries of the currency union depends on a variety of aspects. Since these aspects may vary over time,

the optimum constitution of a monetary union should allow for amendments (see also von Hayen 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 (see Frankel and Rose (1997 and 1998)).

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