No. 2393

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INTERNATIONAL MACROECONOMICS

Centre for Economic Policy Research

ISSN 0265-8003

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Discussion Paper No. 2393
February 2000

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CEPR Discussion Paper No. 2393

February 2000

ABSTRACT

Monetary Policies In The Presence Of Asymmetries*

In this Paper we study the theory of monetary policy when the monetary authority faces asymmetries in the countries constituting the monetary union. We identify two asymmetries (shocks and transmission) in the context of a two-country model. A general finding is that as the degree of asymmetries increases, the effectiveness of stabilization of output and unemployment is reduced. As a result, when asymmetries increase, the stabilization effort of the central bank declines for given preferences about stabilisation. We also find that the central bank can improve the efficiency of its monetary policies when asymmetries in the transmission exist, by using national information in the setting of optimal policies. The declared strategy of the ECB conflicts with this prescription. In practice, however, the ECB is likely to follow this prescription.

JEL Classification: F33, F36, F42
Keywords: EMU, monetary policy, asymmetric shocks, asymmetric transmission

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* This paper was funded with help from FWO - Vlaanderen, nr. G.0227.00.

Submitted 11 February 2000

NON-TECHNICAL SUMMARY

The monetary policy regime in Europe has changed drastically since 1 January 1999. Since that date, national monetary policies of the EMU-member countries are completely centralized in the hands of one central monetary authority. At the same time, however, national central banks continue to exert an important influence on this policy-making process. In this sense it can be said that the Eurosystem combines unity of decisions with participation of national central banks in the decision-making process and in the practical implementation of these decisions.

This institutional structure has come about as a compromise between the need to unify the decision-making process in a monetary union and the desire of national central banks to be involved in this process. The decentralized structure of the Eurosystem has both advantages and disadvantages. The advantage is that it allows for a maximum of information regarding the local economic conditions to filter through in the decision process. The disadvantage is that too much focus on local conditions can paralyse decision-makers when each of them attaches a large weight to the economic conditions of the country they originate from.

In order to avoid the latter problem, the Treaty stipulates that the national governors in the Governing Council shall act to represent the interests of Euroland as a whole. There is no doubt that the national governors have started with the intention of fulfilling their European mandate. There is also no doubt that the national interests will continue to loom large, especially when economic conditions diverge systematically in Euroland.

The purpose of this Paper is to analyse problems of monetary policy-making in an environment like Euroland. This is characterized by the existence of nation-states with their own idiosyncrasies and policy-makers who take decisions jointly but also keep the interests of their countries in the back of their minds.

In this Paper we analyse the problem of monetary policies in an asymmetric environment assuming a two-country model. The loss function of the common central bank consists of a weighted average of the loss functions of the national central banks participating in the decision process. The structure of the economy is a simple forward-looking Phillips curve. The shocks and the transmission process differ as between countries. We derive the optimal policy of the common central bank.

A general finding is that as the degree of asymmetries increases, the effectiveness of stabilization of output and unemployment is reduced. As a result, when asymmetries increase, the stabilisation effort of the central bank declines for given preferences about stabilization. Thus, if the asymmetries (either in shocks or in transmission) are high the central bank will be perceived to be conservative, even though it is not, in terms of its declared preferences.

We also find that the central bank can improve the efficiency of its monetary policies when asymmetries in the transmission exist, by using national information in the setting of optimal policies. The declared strategy of the ECB conflicts with this prescription. In practice, however, the ECB is likely to follow this prescription.

1. Introduction

The monetary policy regime in Europe has changed drastically since January 1, 1999. Since that date, national monetary policies of the EMU-member countries are completely centralised in the hands of one central monetary authority. At the same time, however, national central banks continue to exert an important influence on this policy-making process. We illustrate this by a flow chart (Figure 1) describing the decision making process within the European System of Central Banks (the Eurosystem). It can be seen that the Eurosystem combines unity of decisions with participation of national central banks in the decision making process and in the practical implementation of these decisions.

This institutional structure has come about as a compromise between the need to unify the decision making process in a monetary union and the desire of national central banks to be involved in this process. The decentralised structure of the Eurosystem has both advantages and disadvantages. The advantage is that it allows for a maximum of information regarding the local economic conditions to filter through in the decision process. The disadvantage is that too much focus on local conditions can paralyse decision-makers when each of them attaches a large weight on the economic conditions of the country they originate from.

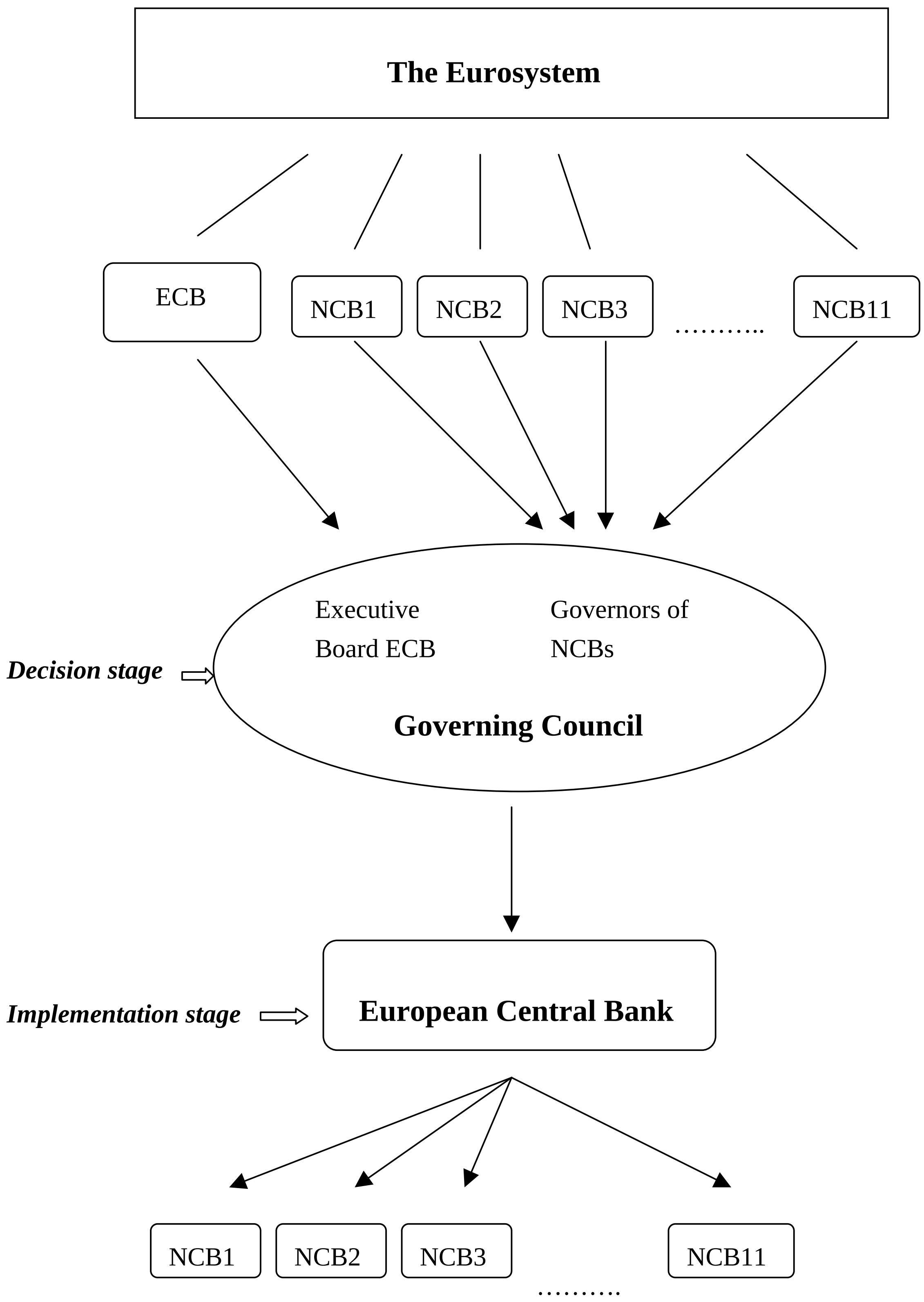
In order to avoid the latter problem the Treaty stipulates that the national governors in the Governing Council shall act to represent the interests of Euroland as a whole. There is no doubt that the national governors have started well intentioned to fulfil their European mandate. There is also no doubt that the national interests will continue to loom large, especially when economic conditions diverge systematically in Euroland.

The purpose of this paper is to analyse problems of monetary policy making in an environment like the Euroland one. This is characterised by the existence of nation-states with their own idiosyncrasies, and policy-makers who take decisions jointly but also keep the interests of their countries in the back of their minds.

In this paper we analyse the problem of monetary policies in an asymmetric environment assuming a two-country model. This is certainly a shortcoming. In another paper we generalise the analysis to eleven countries[1].

[1] De Grauwe, Dewachter and Aksoy(1999).

Figure 1: Organisational framework of Eurosystem



2. A two-country model

We will assume that the countries are the individual agents whose welfare is maximised. The decision process, however, is unified. One way this idea can be formalised is by specifying the following loss function of the Eurosystem:

$$L_E = \alpha L_R + (1-\alpha) L_F \quad (1)$$

where L_R and L_F are the loss functions of countries R and F, both members of the Eurosystem, and α is the share of country R. The parameter α can be interpreted as the weight given to country R in the decision process. This may or may not be related to the economic weight of the country. It will be remembered that in the Eurosystem one country has one vote, irrespective of its size[2]. In the following we will generally set $\alpha = 0.5$, assuming that both countries have the same weight in the decision process.
The loss function of each individual country is written as

$$L_R = \pi_R^2 + b\left(U_R - U_R^*\right)^2 \quad (2)$$

$$L_F = \pi_F^2 + b\left(U_F - U_F^*\right)^2 \quad (3)$$

where π_R and π_F are the rates of inflation in countries R and F, U_R and U_F are the unemployment rates in R and F, and U^*_R and U^*_F are the natural rates of unemployment in both countries. Thus we assume that the national authorities abstain from pursuing a target unemployment rate below the natural level (see Blinder 1998 on this issue). This ensures that there will be no inflation bias. An alternative interpretation of (2) and (3) is that (U_R-U^*_R) and (U_F-U^*_F) are the output gaps that the authorities wish to minimise[3].

We make two further assumptions. First, it is assumed that the weight the authorities attach to unemployment (output) stabilisation, b, is the same. Thus, the national central bankers participating in the joint decision process have the same preferences about the importance of the inflation objective relative to stabilisation. We introduce this assumption because we want to focus the attention on asymmetries of shocks and asymmetries in the transmission process. This assumption could easily be relaxed.

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[2] Things are a little more complicated because the members of the ECB-Board also have a nationality so that some countries have two votes. It is then assumed that the members of the ECB Board vote national.

[3] This has now become the standard approach to the theory of monetary policy. See Clarida, Gali and Gertler(1999), Svensson(1999), McCallum(1999).

Second, it is assumed that inflation is equal in the two countries, i.e. $\pi_R = \pi_F = \pi$. Put differently the Eurosystem sets a common inflation rate that will prevail in the whole union. We also assume that the monetary authorities directly set the rate of inflation. In a more complicated version of the model one could introduce an equation linking the inflation rate to the instrument of monetary policy (e.g. the money stock, or the short-term interest rate). We will not do this here.

The next step in the analysis consists in specifying the Phillips curves that prevail in the two countries:

$$U_R = U_R^* - a_R\left(\pi - \pi^e\right) + \varepsilon_R \tag{4}$$

$$U_F = U_F^* - a_F\left(\pi - \pi^e\right) + \varepsilon_F \tag{5}$$

where a_R and a_F are the respective slopes of the short-term Phillips curves in the two countries and ε_R and ε_F represent stochastic disturbances in the two countries. Asymmetries appear in two forms in this model. One is an asymmetry in the disturbances, the other is an asymmetry in the transmission process as represented by the slopes of the Phillips curves. An alternative interpretation of (4) and (5) is to consider these to be supply equations, in which inflation surprises affect the output gap. In this interpretation the coefficients a_R and a_F are negative.

The decision process in EMU is now assumed to be organised as follows. Each central bank computes its loss given the shock it observes in its domestic Phillips curve (supply equation). This loss is then aggregated by giving the suitable weights (as represented in equation(1)). The central bankers then compute the first order condition of this aggregated loss function, which then determines the optimal inflation that will be applied to the whole of Euroland[4]. Algebraically we substitute (4) and (5) into (2) and (3) and then into (1). This yields:

$$L_E = \pi^2 + \alpha b\left[a_R\left(\pi^e - \pi\right) + \varepsilon_R\right]^2 + (1-\alpha)b\left[a_F\left(\pi^e - \pi\right) + \varepsilon_F\right]^2 \tag{6}$$

We then compute

$\dfrac{dL_E}{d\pi} = 0$ and solve for π

[4] In De Grauwe, Dewachter and Aksoy(1999) it is shown that a majority rule produces an outcome postulated here.

This yields:

$$\pi = \frac{b\left[\alpha a_R^2 + (1-\alpha)a_F^2\right]}{1+b\left[\alpha a_R^2 + (1-\alpha)a_F^2\right]}\pi^e + \frac{b\left[\alpha a_R \varepsilon_R + (1-\alpha)\alpha_F \varepsilon_F\right]}{1+b\left[\alpha a_R^2 + (1-\alpha)a_F^2\right]} \tag{7}$$

We now introduce the rational expectations assumption which implies that agents in the two countries set their forecasts of inflation π^e equal to π obtained from expression (7). This yields:

$$\pi^e = 0 \tag{8}$$

and

$$\pi = \frac{b\left[\alpha a_R \varepsilon_R + (1-\alpha)a_F \varepsilon_F\right]}{1+b\left[\alpha a_R^2 + (1-\alpha)a_F^2\right]} \tag{9}$$

It is useful to compare this solution to the solution obtained when the two countries are identical, i.e. experience the same shocks and exhibit the same transmission mechanism, i.e. $a_R = a_F$ and $\varepsilon_R = \varepsilon_F$:

$$\pi = \frac{ba\varepsilon}{1+ba^2} \tag{10}$$

This is nothing but the solution of a one-country model. Thus, the optimal inflation rate set by the Eurosystem uses a weighted average of the shocks that occur in each country and a weighted average of the transmission coefficients.

Substituting (9) into the national Phillips curves yields the unemployment rates that prevail in the two countries taking into account the optimal policy set by the Eurosystem:

$$U_R = U_R^* + \frac{(1-\alpha)a_F^2 b\varepsilon_R + \varepsilon_R - (1-\alpha)a_R a_F b\varepsilon_F}{1+b\left[\alpha a_R^2 + (1-\alpha)a_F^2\right]} \tag{11}$$

$$U_F = U_F^* + \frac{\alpha a_R^2 b\varepsilon_F + \varepsilon_F - \alpha a_R a_F b\varepsilon_R}{1+b\left[\alpha a_R^2 + (1-\alpha)a_F^2\right]} \tag{12}$$

In order to analyse the impact of the asymmetries on the optimal policies we analyse two cases:

- countries are identical in transmission structure, but experience different shocks, i.e. $a_R = a_F$ and $\varepsilon_R \neq \varepsilon_F$
- countries have different transmission mechanism ($a_R < a_F$) but experience symmetric shocks, $a_R \neq a_F$ and $\varepsilon_R = \varepsilon_F$

3. The model under asymmetric shocks

In this section we take up the first case, i.e. countries have the same transmission mechanism but face different shocks: ($\varepsilon_R \neq \varepsilon_F$, but $a_R = a_F$)[5]. In order to facilitate the discussion we will assume that both countries have the same weight in the decision process, i.e. $\alpha = 0.5$. The optimal inflation can then be written as:

$$\pi = \frac{0.5ba(\varepsilon_R + \varepsilon_F)}{1 + ba^2} \tag{13}$$

and the ensuing unemployment rates in the two countries become

$$U_R = U_R^* + \frac{0.5ba^2(\varepsilon_R - \varepsilon_F) + \varepsilon_R}{1 + ba^2} \tag{14}$$

$$U_F = U_F^* + \frac{0.5ba^2(\varepsilon_F - \varepsilon_R) + \varepsilon_F}{1 + ba_2} \tag{15}$$

We now turn to the question of how much stabilisation of unemployment (output) there will be when asymmetric shocks occur. In order to do so, we compute the variance of the expressions (13) to (15):

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5 There is a large literature analysing the importance of asymmetric shocks. See e.g. Bayoumi and Eichengreen(1993), (1997), Artis and Zhang(1995), Gros and Thygesen(1997), Melitz and Zumer (1999), and many others.

$$\text{var } \pi = 0.25\left[\frac{ba}{1+ba^2}\right]^2 [\text{var } \varepsilon_R + \text{var } \varepsilon_F + 2 \text{ cov } \varepsilon_R\varepsilon_F) \tag{16}$$

This can also be rewritten as (where we assume that var ε_R = var ε_F)[6]

$$\text{var } \pi = 0.5\left[\frac{ba}{1+ba^2}\right]^2 [1+\rho] \text{ var } \varepsilon \tag{17}$$

$$\text{var } U_R = \text{var } U_F = \frac{1+ba^2(1+0.5ba^2)(1-\rho)}{(1+ba^2)^2} \text{var } \varepsilon \tag{18}$$

where ρ is the correlation coefficient of the national shocks ε_R and ε_F

We can now establish the following results:

- ✓ When the correlation coefficient, ρ = -1 (i.e. there is perfect asymmetry in the shocks), var π = 0. This means that the Eurosystem does not adjust the optimal inflation rate to the shocks that occur in the two countries. There is no stabilisation at all. In this case the variability of unemployment is given by var U_R = var U_F = var ε. Put differently, since the Eurosystem authorities do not adjust the inflation rate so as to accommodate for shocks the variability of unemployment is exactly equal to the variability of the underlying shocks. The intuition behind this result is that with perfect asymmetry, the national desires about the optimal policy exactly offset each other, so that there is a stalemate in the decision process and nothing is done. The Eurosystem then behaves as if it is a super-conservative central bank which sets the weight on unemployment (output) stabilisation equal to zero. Note, however, that underlying this behaviour there may (or may not be) a strong preference for stabilising unemployment (output), as measured by b.
- ✓ The other extreme is one of perfect symmetry of shocks, i.e. ρ = 1. We then find that

$$\text{var } \pi = \left[\frac{ba}{1+ba^2}\right]^2 \text{ var } \varepsilon$$

[6] A justification for this assumption is that the two countries are of equal size. Note that we use the equality cov $\varepsilon_R\varepsilon_F = \rho\sqrt{\text{var }\varepsilon_R \text{ var }\varepsilon_F}$.

and $\text{var } U_R = \text{var } U_F = \dfrac{1}{\left[1+ba^2\right]^2} \text{ var } \varepsilon$

These are the same results as those obtained in the one country model. The Eurosystem then has the same stabilising features as in the case of one country.

✓ More generally, we find that the degree of stabilisation exerted by the Eurosystem is a positive function of the correlation of the shocks. With an increasing ρ the Eurosystem increases its stabilisation effort, for any given b. Thus, when the governors of the Eurosystem do not change their preferences (as given by b) an increase in ρ induces them to stabilise more. Conversely, even if the governors' preferences do not change, a decline in ρ leads them to reduce their stabilisation efforts.

From the preceding analysis one learns that there is a similarity between stabilisation preferences and correlation of shocks. In order to investigate the nature of this relationship, we rewrite (18) as follows:

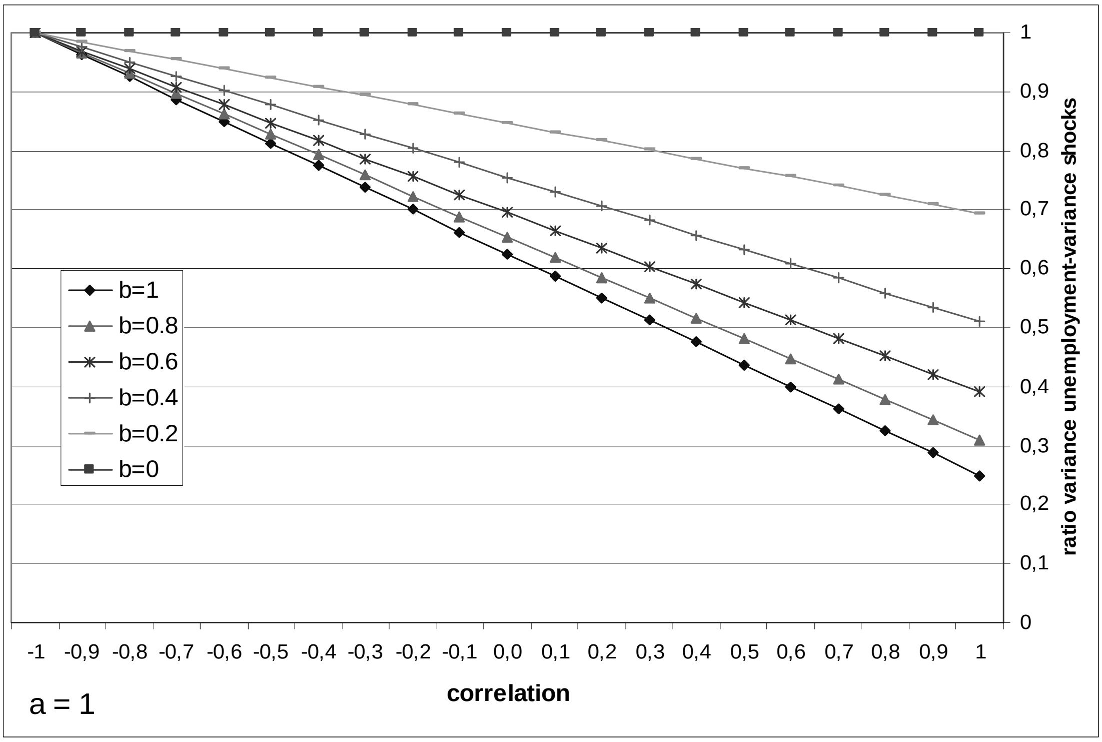
$$\sigma = \frac{\text{var}\, U_R}{\text{var}\, \varepsilon} = \frac{1+ba^2\left(1+0.5ba^2\right)(1-\rho)}{\left(1+ba^2\right)^2} \qquad (19)$$

The ratio $\sigma = \dfrac{\text{var}\, U_R}{\text{var}\, \varepsilon}$ measures the fraction of the variance in the disturbances ε that filters through into unemployment (output) variability. The smaller is this fraction the greater is the stabilisation effort.

We first show the relation between σ and ρ (the correlation coefficient) for given values of the unemployment stabilisation parameter, b, in figure 2 (Note that we have set the coefficient of the Phillips curve a=1). We observe that an increase of the correlation of shocks (i.e. there is increasing symmetry of shocks) reduces σ, i.e. increases the stabilisation for any given preferences as measured by b. We also note that this effect weakens as b declines. In other words, if the Eurosystem attaches a low weight to unemployment stabilisation, the increase in the correlation of shock has only small effects on stabilisation. In the limit, if b=0, the correlation of shocks does not affect the stabilisation outcome. Conversely, if the stabilisation preference is high, then a decline in the correlation (i.e. an increase in the asymmetry of shocks) frustrates the Eurosystem authorities in their attempt at stabilising unemployment.

We can formulate these results in a somewhat different way. The lower the correlation of shocks the greater the discrepancy between the ECB's desire to stabilise (as measured by b) and the actual stabilisation outcome (as measured by σ). This discrepancy is itself a function of b. When b becomes very small, i.e. the central bank does not care much about stabilisation, the discrepancy between desires and outcomes declines.

Figure 2: Correlation of shocks and stabilisation outcome



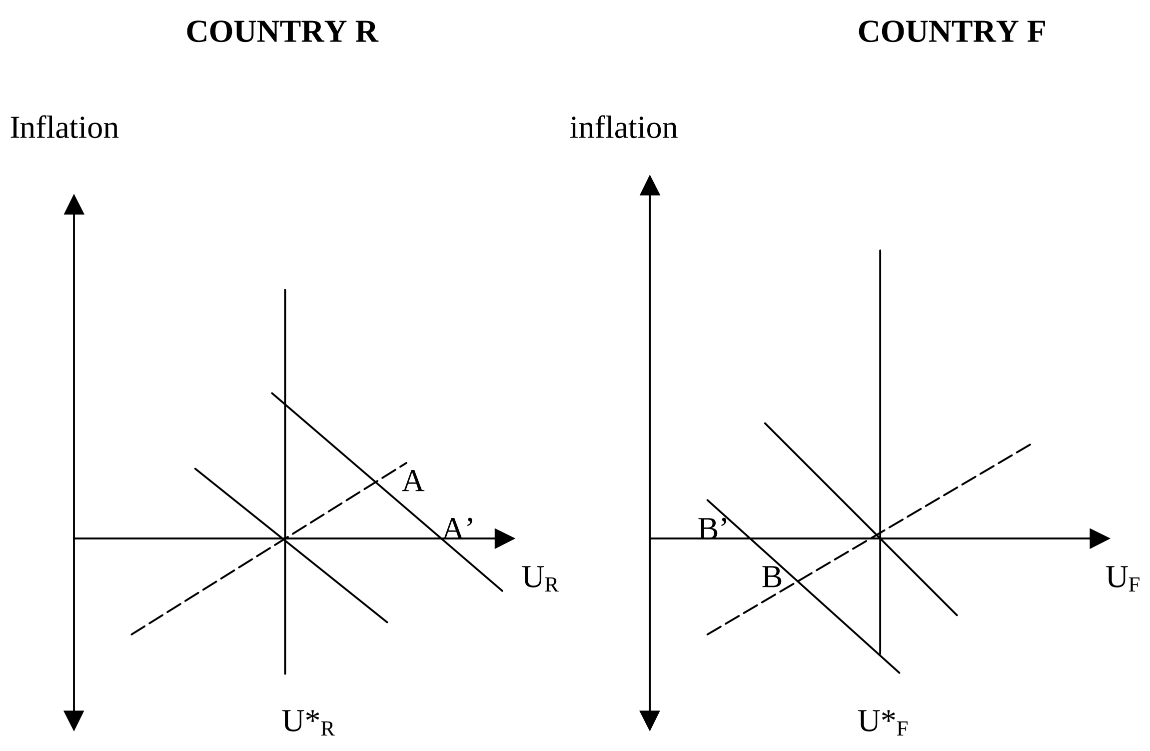
4. A graphical interpretation.

In this section we give a graphical interpretation to our results. In figure 3 we present the model. The negatively sloped lines are the short-term Phillips curves (equations (4) and (5)). We assume the same slope in the two countries. The vertical line is the long-run trade-off corresponding to the natural unemployment. The upward sloping dotted lines represent the optimal response of the each country to shocks in the Phillips curve. They are obtained by computing the ratio of the variances of inflation and unemployment (equations(17) and (18)). We will call these lines the optimal stabilisation lines. They are identical in the two countries because the authorities have the same preferences, and because the transmission processes are identical.

In figure 3 we represent the case of a ‘pure’ asymmetric shock: country R experiences a rightward shift in its short-term Phillips curve, while country F experiences a leftward shift of the same magnitude. The preference of country R would be to go to point A, and of country F to go to point B. These preferences must be aggregated to arrive at one decision. In this case, because the two countries are of equal size their preferences exactly offset each other. As a result, the ECB does not react to the shocks. There is no stabilisation at all. The optimal inflation remains zero. Country R’s unemployment is A’ and country F’s B’.

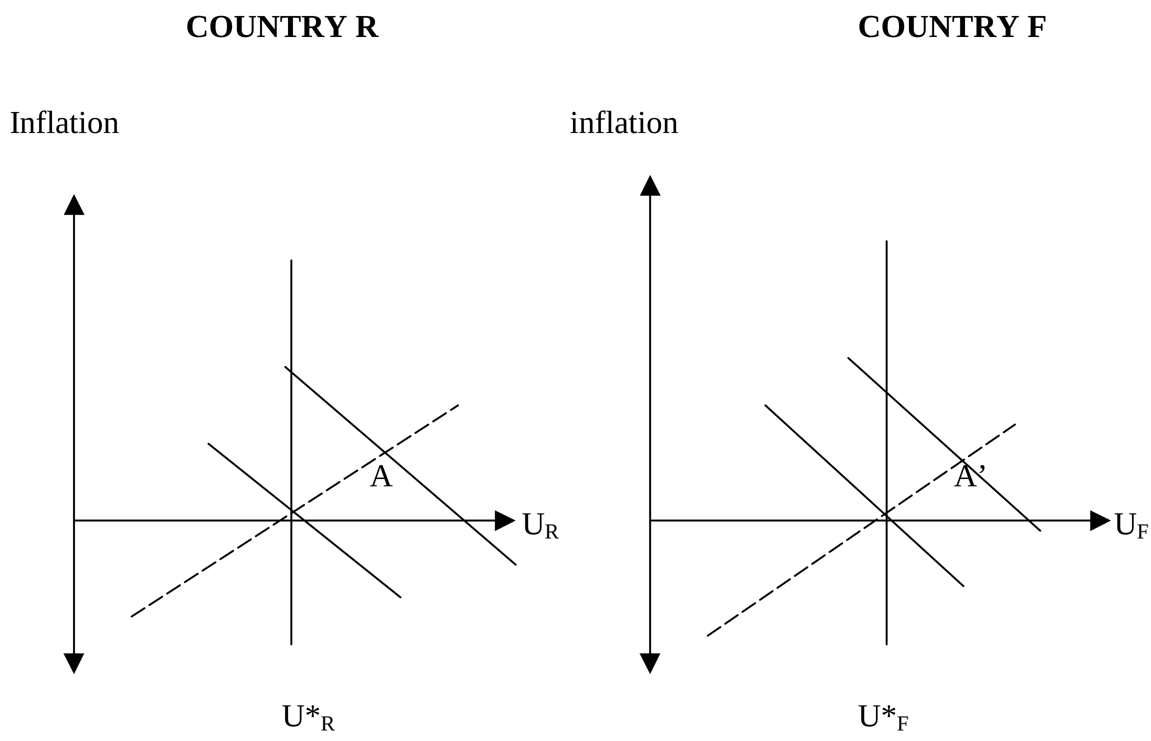
In this extreme case of a pure asymmetric shock, the ECB never stabilises. The ECB is completely paralysed. It behaves as if the weight it attaches to unemployment stabilisation is zero. As a result, unemployment (output) in the individual countries fluctuate not around positive expansion paths but around a horizontal line. The ECB will be perceived as super conservative in the countries involved.

Figure 3: Asymmetric shocks and monetary policy of the ECB



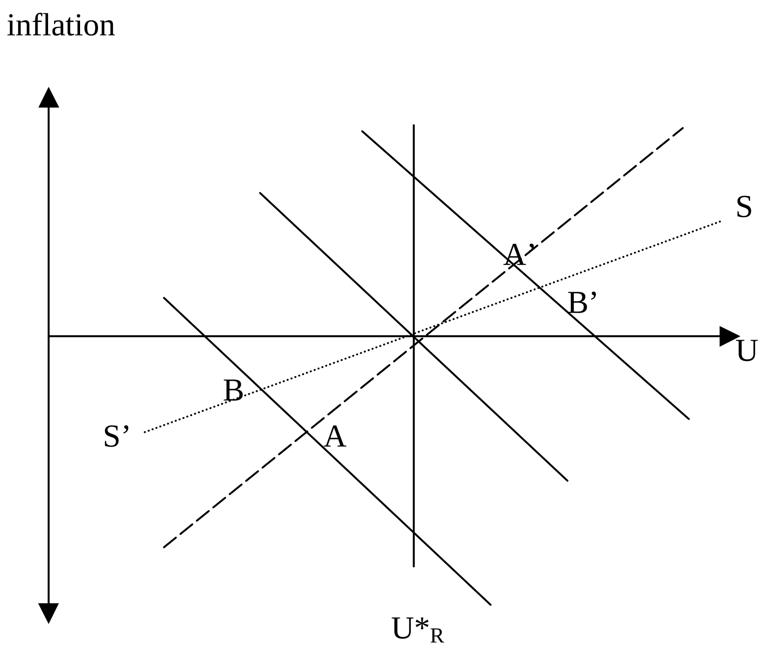
The symmetric case is shown in figure 4. We now assume that the shock is exactly the same in both countries, i.e. the short-term Phillips curve shifts upwards in both countries. Both countries have the same desire to raise the optimal inflation rate. The aggregate outcome is for the ECB to take action and to follow an expansionary monetary policy. We move to points A and A'.

Figure 4 : Symmetric shock



Thus, the effectiveness of the ECB to stabilise output in individual countries depends on whether the shocks are symmetric or asymmetric. In practice, shocks will always be some mixture of symmetric and asymmetric movements. We illustrate this in figure 5, where we show an individual member state. We assume that the short-term Phillips curve moves up and down in an unpredictable way. When these shocks are purely asymmetric, the ECB does nothing so that unemployment varies along the horizontal axis. If these shocks in the Phillips curve are purely symmetric, the ECB will stabilise to the extent given by its optimal stabilisation line. Unemployment will then fluctuate between the points A and A'. We show the more likely intermediate case where the shock is a combination of symmetry and asymmetry. In this case the stabilisation will be given by the line SS which is intermediate between the pure asymmetry and symmetry cases. Unemployment now fluctuates between the points B and B'. Thus, there will always be too little stabilisation from the point of view of the individual country.

Figure 6 : Optimal stabilisation in Euroland country



5. Monetary policy with asymmetric transmission

In this section we focus on the asymmetry of the transmission process[7]. In order to do so, we will assume that the shocks are symmetric, i.e. $\varepsilon_R = \varepsilon_F$. The asymmetry of the transmission mechanism is reflected by a difference in the coefficients of the short-term Phillips curves. More specifically we set $a_F > a_R$. We interpret this to mean that country F has more flexibility in the labour market, while country R is characterised by more rigidity in its labour market.

Using equation (9) and assuming equal sized countries (α=0.5) we obtain the optimal π :

[7] Some recent papers analyse the importance of asymmetric transmission. See e.g. Dornbusch, Favero and Giavazzi(1998), Cecchetti(1999).

$$\pi = \frac{0.5b\left[a_R + a_F\right]}{1 + 0.5b\left[a_R^2 + a_F^2\right]}\varepsilon \qquad (21)$$

Defining $a_E = 0.5\ (a_R + a_F)$ as the average euro-wide estimate of the slope of the Phillips curve, we can rewrite equation (21) as follows

$$\pi = \frac{ba_E}{1 + b\,{a_E}^2 + b \operatorname{var} a}\varepsilon \qquad (22)$$

where var $a = 0.5\ [(a_R - a_E)^2 + (a_F - a_E)^2]$, which can be interpreted as a measure of the asymmetry in the transmission process.

Taking variances leads to the following expression

$$\operatorname{var}\pi = \left[\frac{b\,a_E}{1 + b\,a_E^2 + b \operatorname{var} a}\right]^2 \operatorname{var}\varepsilon$$

We find that with an increasing var a (i.e. an increasing asymmetry in the transmission process) the monetary authorities react less to shocks. Thus the more the transmission mechanisms differ between countries, the less the authorities adjust the inflation rate to stabilise the economy, for any given b. The intuition behind this result is the following. When the asymmetry in the transmission increases, monetary policies aimed at stabilising unemployment and output become less effective. This leads the central bank to apply less stabilisation. It is as if the preference for stabilisation declines.

Note that if $a_R = a_F \Rightarrow \operatorname{var} a = 0$

so that

$$\pi = \frac{b\,a_E}{1 + b\,a_E^2}$$

and we obtain the usual formula for the optimal inflation rate in a model with one country.

In order to obtain an expression for the variability of unemployment we substitute (22) into each country's Phillips curve. This yields:

$$U_R = U_R^* + \frac{1 + 0.5b\,a_F\left(a_F - a_R\right)}{1 + ba_E^{\;2} + b\,\mathrm{var}\,a}\;\varepsilon \qquad (23)$$

and

$$U_F = U_F^* + \frac{1 + 0.5b\,a_R\left(a_R - a_F\right)}{1 + ba_E^{\;2} + b\,\mathrm{var}\,a}\varepsilon \qquad (24)$$

Taking variances of (23) and (24) yields:

$$\mathrm{var}\,U_R = \left[\frac{1 + 0.5\,b\,a_F\left(a_F - a_R\right)}{1 + b\,a_E^2 + b\,\mathrm{var}\,a}\right]^2 \mathrm{var}\,\varepsilon \qquad (25)$$

$$\mathrm{var}\,U_F = \left[\frac{1 + 0.5\,b\,a_R\left(a_R - a_F\right)}{1 + b\,a_E^2 + b\,\mathrm{var}\,a}\right]^2 \mathrm{var}\,\varepsilon \qquad (26)$$

It can be shown that the denominator of (26) is smaller than the denominator of (25)[8]. It follows that the variance of unemployment is smaller in the flexible country than in the rigid country. This result can be explained as follows. When a (symmetric) shock occurs the ECB reacts by changing its monetary policy (the inflation rate) in a stabilising way. This has the effect of reducing the impact of the shock on unemployment. Since in the flexible country unemployment (and output) react stronger to prices, this stabilising effect of the ECB-policies is stronger than in the rigid country.

How does an increase in the asymmetry of the transmission mechanism (as measured by var a) affect the variance of unemployment? We have seen that when var a increases the variance of the optimal inflation rate declines, i.e. the ECB follows a less activist monetary policy. What does this mean for the variability of unemployment? We show the answer in figure 6 where we present the variance ratio σ as a function of the variance of a. We do this for different values of b. We find that an increase in the asymmetry of the transmission increases the variance of unemployment in the rigid country and reduces it in the flexible country. The latter result comes from the fact that we keep the average (euro) value of the

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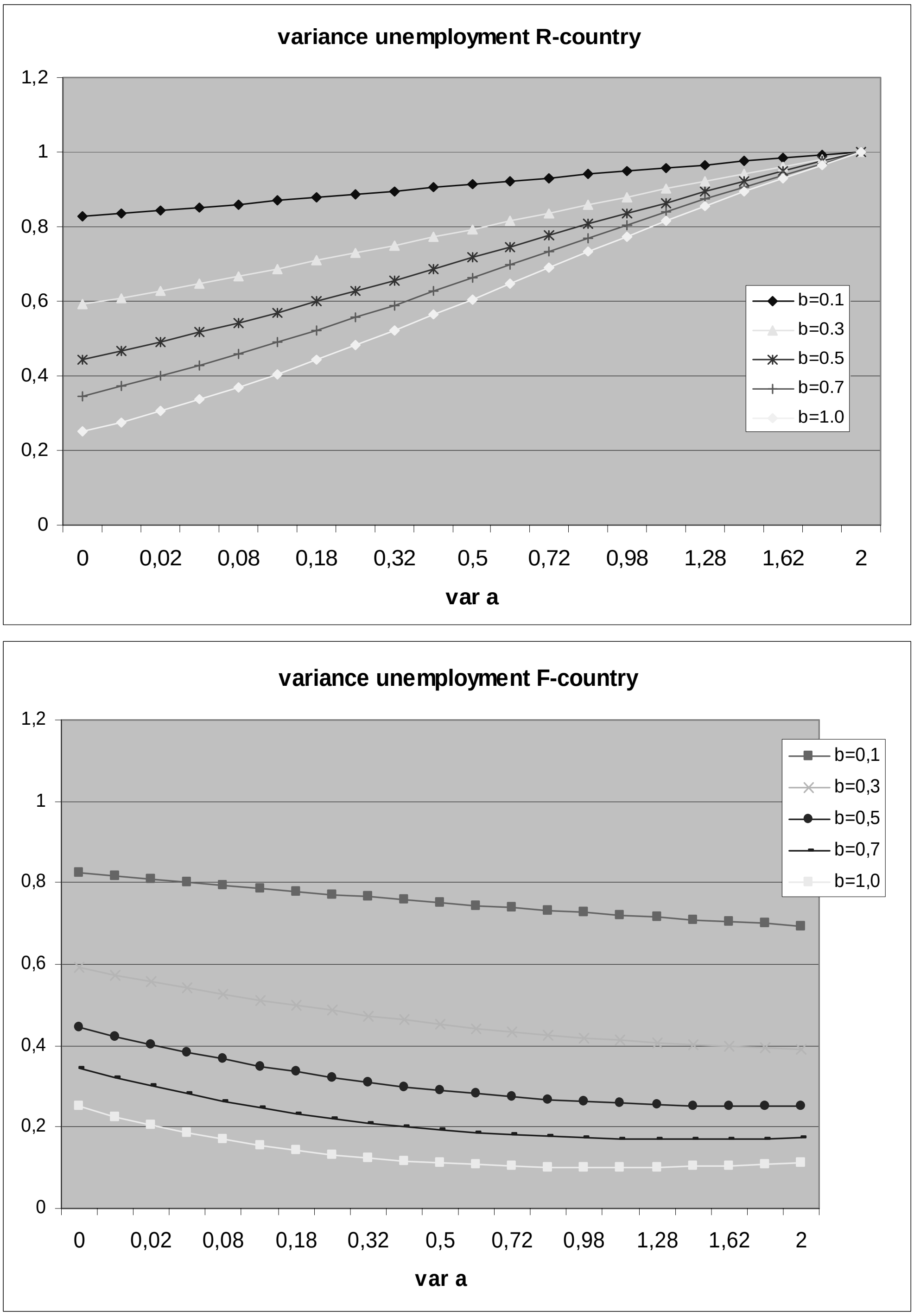
[8] This follows from the fact that $a_F > a_R$

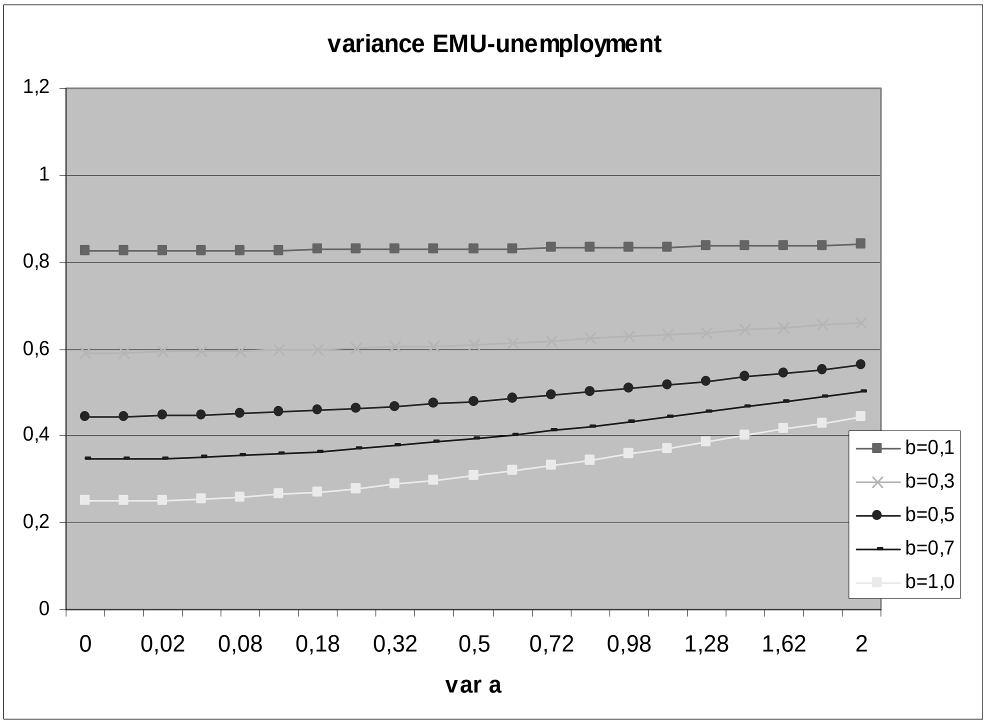
parameter a constant. As a result, an increase in the variance of a makes the flexible country more flexible and the rigid country more rigid.

Figure 6: Variance of unemployment (σ) in R- and F-country



One would also like to know how the asymmetry of the transmission affects the variability of the average unemployment rate in the union as a whole. This is shown in figure 7. We observe that when the asymmetry of the transmission increases, the variability of unemployment for a given shock increases. Thus, one can conclude that with increasing asymmetry, the ECB stabilises less, so that unemployment (output) varies more in the union as a whole.

Figure 7 : Variance of unemployment (σ) in Euroland



6. How to aggregate

In its official pronouncements, the ECB has taken the view that in order to find the optimal policy rule, the national macroeconomic data should first be aggregated into euro-wide averages. These euro-wide data should then form the basis for deriving the optimal policy for Euroland as a whole. This contrasts with the optimising procedure we have followed in this paper, where we assume that the national authorities aggregate their national loss functions (which use national data) through some common decision making process. We will call the first aggregation process, euro-aggregation, and the second, national aggregation.

The procedure proposed by the ECB can be formalised as follows. We start from a euro-wide loss function

$$L_E = \pi^2 + b\left(U_E - U_E^*\right)^2 \tag{27}$$

where L_E is the loss of the ECB, π is the aggregated euro inflation rate, and U_E is the aggregated euro unemployment rate. In this specification it is assumed that the national representatives have agreed to take a euro-wide perspective in setting optimal monetary policies. This also implies that they disregard the national information about inflation and unemployment.

The logic of taking a euro-wide perspective is that the national Philips curves are aggregated into one euro Phillips curve. This becomes

$$U_E = U_E^* - a_E\left(\pi - \pi^e\right) + \varepsilon_E \tag{28}$$

where a_E is an estimate of the euro-wide slope of the short-term Philips curve, and ε_E is the common euro-wide shock in the Phillips curve. We will set $a_E = \alpha a_R + (1-\alpha)a_F$ and $\varepsilon_E = \alpha\varepsilon_R + (1-\alpha)\varepsilon_F$

Substituting (28) into (27) and using the rational expectations assumption, we can derive the optimal rule under euro-aggregation:

$$\pi^e = 0$$

$$\pi = \frac{a_E b}{1 + a_E^2 b}\varepsilon_E \tag{29}$$

and

$$U_E = U_E^* + \frac{1}{1 + a_E^2 b}\varepsilon_E \tag{30}$$

The fact that the ECB only takes into account the aggregated euro-data to derive the optimal rule does not reduce the asymmetries in the shocks and in the transmission processes. We, therefore, analyse the question of how this aggregation procedure affects the efficiency of monetary policies given that these asymmetries exist. We will continue to assume that the countries are the units (agents) whose welfare should be evaluated.

In order to do so, we first substitute the optimal inflation rate obtained from (29) into the national Phillips curves:

$$U_R = U_R^* + \frac{1 + a_E b(a_E - a_R)}{1 + a_E^2 b}\varepsilon_E \qquad (31)$$

$$U_F = U_F^* + \frac{1 + a_E b(a_E - a_F)}{1 + a_E^2 b}\varepsilon_E \qquad (32)$$

We now analyse how the euro-aggregation procedure compares in welfare terms to the national aggregation procedure discussed in the precious sections. As before, we assume two polar cases, asymmetry of shocks with symmetry in transmission process, and symmetry in shocks with asymmetry in transmission

- ***Asymmetry in shocks and symmetry of transmission (*** $a_R = a_F$ and $\varepsilon_R \neq \varepsilon_F$)

In this case the two aggregation procedures lead to the same welfare results. This can be seen by comparing the optimal inflation rate under euro aggregation (29) with the optimal inflation under national aggregation (13). It can be seen that the two expressions are identical when $a_R = a_F$. Thus, however one aggregates, the ECB reacts in the same way to shocks. As a result, the losses will be the same under these different aggregation procedures.

- ***Symmetry of shocks and asymmetries in transmission (*** $a_R \neq a_F$ and $\varepsilon_R = \varepsilon_F = \varepsilon$)

In this case the two aggregation procedures lead to different welfare effects. This can be seen from the fact that the optimal inflation rates set by the ECB differ under the two aggregation schemes. We reproduce these here (equations (29) and (22)):

<u>optimal inflation under euro aggregation</u>:

$$\pi = \frac{ba_E}{1 + ba_E^2}\varepsilon \qquad (29)$$

optimal inflation under national aggregation:

$$\pi = \frac{ba_E}{1 + b\,a_E^{\,2} + b\,\text{var}\,a}\varepsilon \tag{22}$$

The distinctive feature is that under national aggregation the ECB fine-tunes its policies in the sense of allowing them to depend on the degree of asymmetry of the transmission mechanism (as measured by var a), while under euro aggregation the optimal policy is unaffected by the degree of asymmetry of transmission. How does this difference in policy reaction affect welfare? In order to analyse this, we substitute (29), (31) and (32) into the loss functions (1)-(3). Similarly we substitute (22), (23) and (24) into the same loss functions We obtain

Losses under euro aggregation:

$$L_R^{EUR} = \left\{ \left(\frac{ba_E}{1 + ba_E^2} \right)^2 + b\left[\left(\frac{1 + ba_E(a_E - a_R)}{1 + ba_E^2} \right) \right]^2 \right\} \varepsilon^2 \tag{33}$$

$$L_F^{EUR} = \left\{ \left(\frac{ba_E}{1 + ba_E^2} \right)^2 + b\left[\left(\frac{1 + ba_E(a_E - a_F)}{1 + ba_E^2} \right) \right]^2 \right\} \varepsilon^2 \tag{34}$$

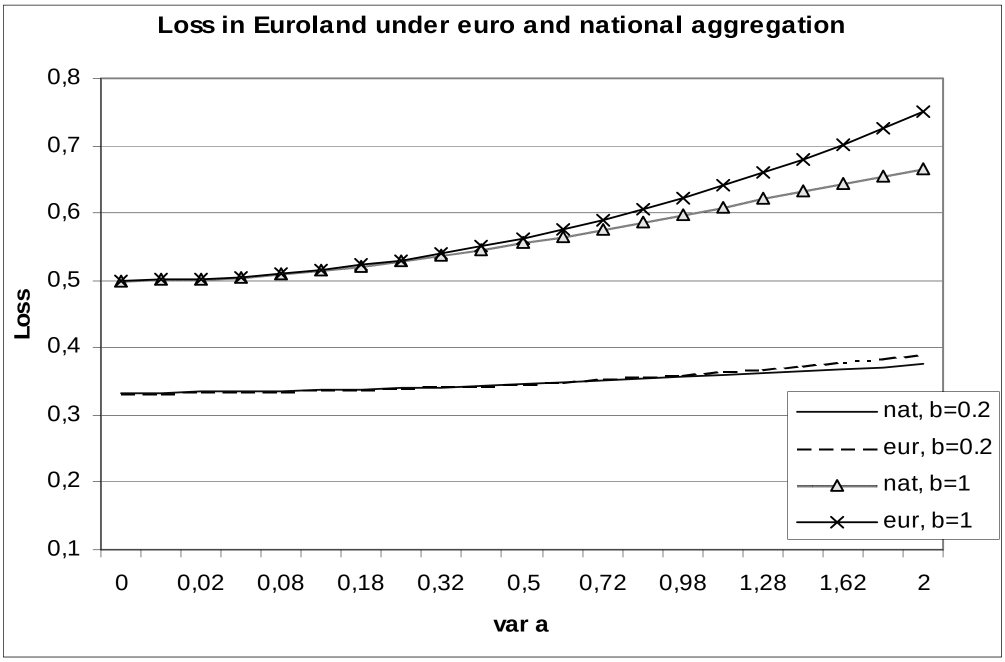
Losses under national aggregation:

$$L_R^{NAT} = \left\{ \left(\frac{ba_E}{1 + ba_E^{\,2} + b\,\text{var}\,a} \right)^2 + b\left[\left(\frac{1 + 0.5ba_F(a_F - a_R)}{1 + ba_E^{\,2} + b\,\text{var}\,a} \right) \right]^2 \right\} \varepsilon^2 \tag{35}$$

$$L_F^{Nat} = \left\{ \left(\frac{ba_E}{1 + ba_E^{\,2} + b\,\text{var}\,a} \right)^2 + b\left[\left(\frac{1 + 0.5ba_R(a_R - a_F)}{1 + ba_E^{\,2} + b\,\text{var}\,a} \right) \right]^2 \right\} \varepsilon^2 \tag{36}$$

The losses for Euroland as a whole are obtained by taking the weighted averages of the national losses according to equation (1). In figure 8 we show Euroland's losses for different values of b and var a. We assume that ε is N{0,1}. We also set $a_E = 1$.

Figure 8:



We find that the losses increase with the degree of asymmetry in the transmission process. This increase depends on the stabilisation desire (b). With a large stabilisation desire an increasing transmission asymmetry increases the losses significantly. This increase is more pronounced when the ECB "euro-aggregates" the data. When the ECB uses national information, losses increase less when the transmission mechanism becomes more asymmetric.

The reason for the lower efficiency of using only euro-wide information (instead of national information) can be seen as follows. Under national aggregation the ECB takes into account the variance in the transmission process. It is aware that with increasing asymmetry in the transmission, monetary policies are less effective in stabilising output and employment. As a result, it applies less stabilisation effort. Thus, inflation will be less variable. The counterpart is that output and unemployment are more variable than under euro aggregation. We show these effects in figures 9 and 10.

Figure 9:

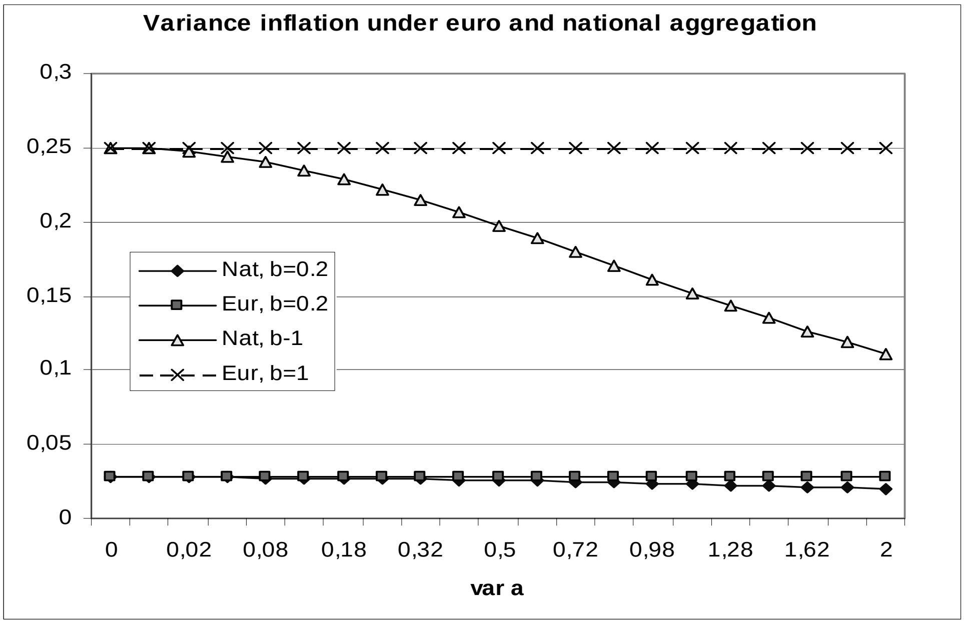
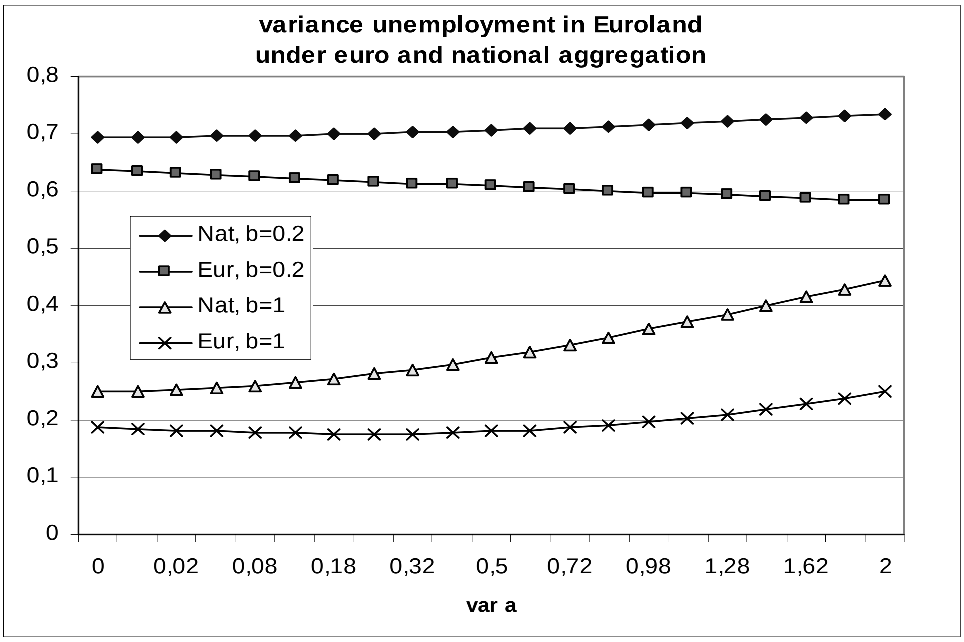


Figure 10:



7. Conclusion

In this paper we have studied the theory of monetary policy when the monetary authority faces asymmetries in the countries constituting the monetary union. We identified two asymmetries. One was an asymmetry in the shocks, the other was an asymmetry in the transmission process of symmetric shocks. We used a simple two-country model to analyse the issues.

A general finding is that as the degree of asymmetries increases, the effectiveness of stabilisation of output and unemployment is reduced. As a result, when asymmetries increase, the stabilisation effort of the central bank declines for given preferences about stabilisation. Thus, if the asymmetries (either in shocks or in transmission) are high the central bank will be perceived as conservative, even though it is not, in terms of its declared preferences.

We also found that the central bank can improve the efficiency of its monetary policies when asymmetries in the transmission exist, by using national information in the setting of optimal policies. The declared strategy of the ECB conflicts with this prescription[9]. In practice the ECB is likely to follow this prescription, however.

The model used in this paper is a very simple one. It can be extended in different directions. One consists in bringing more dynamics into the model. This is left for future research.

[9] See ECB, Monetary Policy Strategy, Monthly Bulletin, January 1999.

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